The HANDBOOK of KINEMATOGRAPHY

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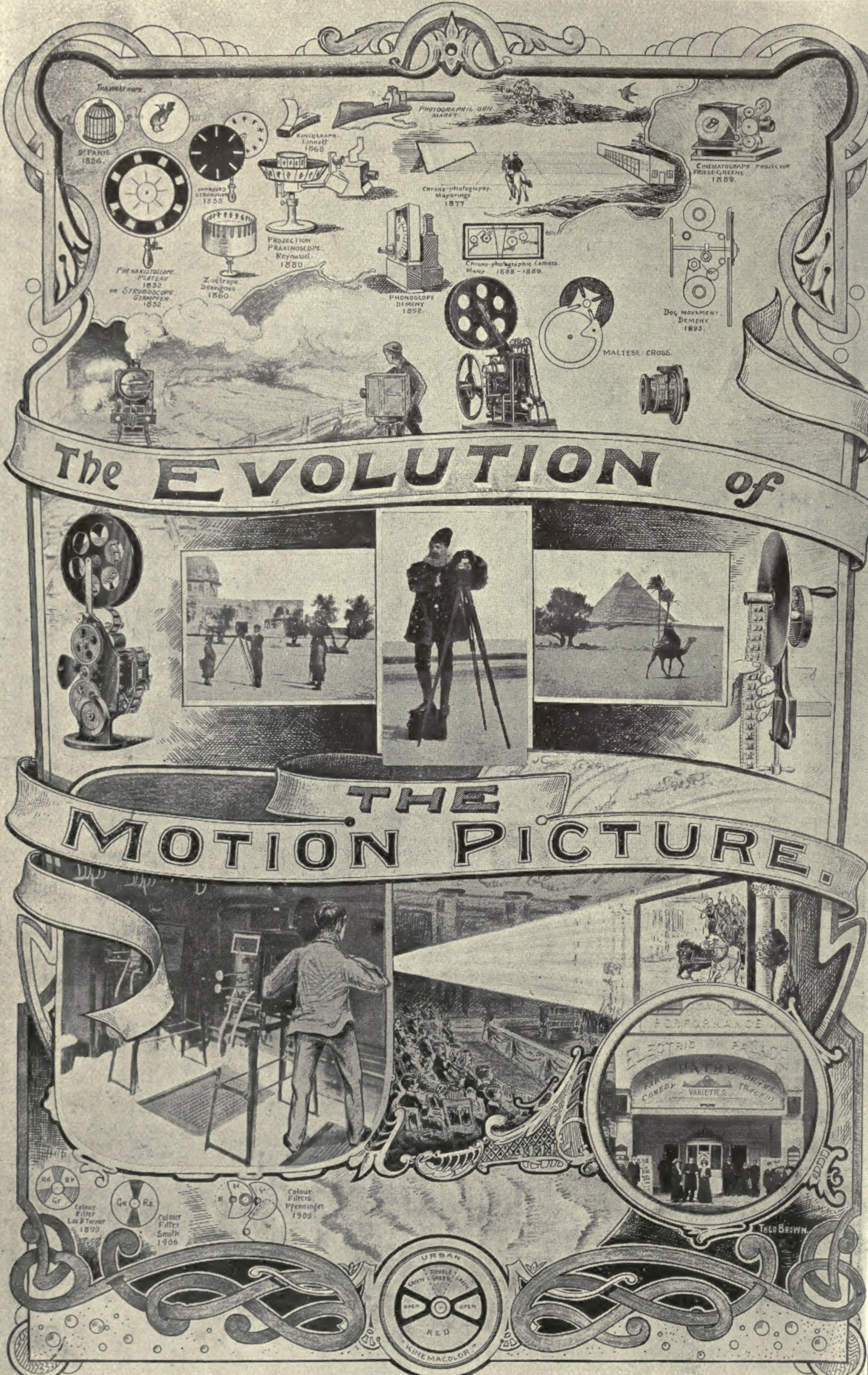

The Evolution of
The
Motion Picture.
Thaumatrope.
Dr. Paris.
1826.
Phenakistoscope.
Plateau
1832
or Stroboscope.
Stampfer.
1832.
Improved
Stroboscope
1855
Zoetrope.
Desvignes.
1860.
Kinegraph.
Linnett
1868
Projection
Praxinoscope.
Reynaud.
1880.
Photographic gun.
Marey.
Chrono-photography.
Muybridge
1877
Phonoscope.
Demeny
1892.
Chrono-photographic Camera.
Marey 1888 - 1889.
Cinematograph projector
Friese-Greene
1889.
Dog movement.
Demeny
1893.
Maltese Cross.
Colour
Filter
Lee & Turner
1899
Colour
Filter
Smith
1906.
Colour
Filters.
Pfenninger.
1909.
Performance
Electric Palace
Pathe
Farce
Comedy
Varieties
Drama
Tragedy
Theo Brown.
Urban
Double Green
Green
Green
Open
Open
Red
Kinemacolor

THE HANDBOOK OF KINEMATOGRAPHY.

THE HISTORY, THEORY, AND PRACTICE OF MOTION PHOTOGRAPHY AND PROJECTION.

BY

COLIN N. BENNETT, F.C.S.

AND COLLABORATORS.

1911.

Published by
THE KINEMATOGRAPH WEEKLY.
Tottenham Street,
LONDON.

PUBLISHERS' FOREWORD.

In 1905 *we converted* THE MAGIC LANTERN JOURNAL, *for thirteen years successfully conducted by Mr. J. Hay Taylor, into* THE OPTICAL LANTERN AND CINEMATOGRAPH JOURNAL. *For two years this monthly publication met the exigencies of the growing trade, and on May* 16*th*, 1907, *we launched a sixteen page weekly entitled* THE KINEMATOGRAPH AND LANTERN WEEKLY. *This has grown until at the present time it has become a bulky periodical of about one hundred pages at each issue.*

Notwithstanding these enormous strides, which have developed in ratio to the wonderfully increasing popularity of Motion Pictures, there has not yet been produced a standard handbook containing information on every department of kinematography, that could be utilised by those desiring to enter the profession, or could be referred to with confidence by those anxious to perfect their knowledge in the science. That the time is ripe for such a work is proved by the numerous technical, legal and varied questions which we have answered from time to time in our pages, and by the very many applications we have received for such a book.

The varied knowledge—photography, electricity, stage managership, legal and local necessities and what not—however, make the production of such a work no easy task. After much consideration, we arranged for Mr. Colin N. Bennett, F.C.S., an expert in photography and kinematography, and a well-known writer on scientific matters to collaborate with experts in the legal, business, and other cognate branches of the subject, and to produce an exhaustive book worthy of what has now become a gigantic industry.

Naturally, certain sections which are subsidiary to the actual practice of kinematography, have had to be somewhat curtailed, but those worthy of more space than we can command here, will be issued as separate publications. Already two are in the press, " Playing to Pictures," by W. Tyacke George, and " How to Manage a Picture Show," by A. E. Taylor.

No book on kinematography can be called exhaustive—new ideas and inventions seem hourly to add improvements to the subject—but in these pages will be found carefully compiled data and useful information, much of it the result of original investigation, while the bulk of the information comprised in Part I. is to be obtained from no other written source, and we trust the labour expended upon the production of the present volume may justify us in issuing it.

We anticipate that this first edition will soon become exhausted, so that a revised edition may become necessary. To help us to make this second edition nearer perfection, we shall be gratified if any reader discovers an error, either of commission or omission, in the present work, if he will acquaint us with particulars

E. T. Heron and Co

AN ACKNOWLEDGMENT.

First and foremost, my acknowledgments and thanks are due to MR. E. T. HERON, *the existence of this volume being a result of his initiative, created from a genuine and ceaseless endeavour to improve the conditions and prospects of the kinematograph industry. Mr. Heron has taken an untiring interest in the present* HANDBOOK OF KINEMATOGRAPHY *from its inception onwards, and the author is indebted to him for countless facts and helpful suggestions contained within its pages. Acknowledgments are further due, and are herewith tendered to* MR. HENRY MORRELL, *of His Majesty's Theatre, Haymarket, W., for the chapter contributed by him on "Acting before the Kinematograph," as also to* MR. A. E. TAYLOR *for the chapter "Playing to Pictures," to the Legal Expert of the* KINEMATOGRAPH WEEKLY *for the important chapter on "The Law and the Kinematograph," to* MR. THEODORE BROWN *for the original drawings, and lastly, to the numerous firms in the trade including* MESSRS. R. R. BEARD, R. AND J. BECK, LTD., F. J. BROCKLISS, W. BUTCHER AND SONS, LTD., EMIL BUSCH, J. H. DALLMEYER, LTD., THE GAUMONT CO., LTD., L. KAMM AND CO., KINETO, LTD., INFALLIBLE METER EXPOSURE CO., PATHE FRERES, LTD., VOIGHTLANDER AND CO., THE WALTURDAW CO., LTD., WATKINS AND CO., WILLIAMSON KINEMATOGRAPH CO., LTD., WRENCH AND CO., CARL ZEISS, LTD., *etc.*

COLIN N. BENNETT,

Author's Historical Preface.

The history of the kinematograph is long, complex, and infinitely stodgy. It is long because it reaches back from now till at least the year 65 B.C., at which date Lucretius, in his work "De Rerum Natura," made certain pertinent remarks relative to persistence of vision—the rock upon which the whole theory of motion photography is built. It is complex by reason of the way in which evolution of the kinematograph proper has in its latter days been crossed and re-crossed by inventions and patents partly, yet not fully, relevant to the moving photograph machine. It is stodgy as cheap plum duff is stodgy, with many an interesting spot here and there, but oceans of plainness between.

Let us leave the full history of the subject for those who like it. It would fill the whole of our book were we to let it do so. As a matter of fact it has filled the whole of a very excellent historical work—"Hopwood's Living Pictures," published 1899—and though the volume in question is long since hopelessly out-of-date from the practical point of view, its retrospect of kinematograph invention prior to 1897 is none the less sound and interesting to the man of antiquarian tendencies.

The endeavour of this preface is solely to set forth in condensed form a few of the most salient facts connected with the infancy and growth of motion pictures.

Let us begin with Ptolemy. Lucretius has already had his turn. Ptolemy was a Greek philosopher who wrote a book, or rather a series of books, on optics, about the year A.D. 130. In one of these he not only took note of the fact of "persistence of vision," which is the scientific way of setting down the truth that the sensation of light coming from an object remains in the brain for the tenth to the twentieth part of a second after the object's actual disappearance, but Ptolemy also described a simple piece of apparatus in the form of a revolving disc with spots on it wherewith this phenomenon might be demonstrated. Like many other valuable principles, Ptolemy's was duly conserved and handed down from age to age and from sage to sage, never being entirely forgotten, never being made the slightest use of till the year 1825, which saw the birth of that modest yet amazing optical toy, the Thaumatrope.

What is the Thaumatrope? Perhaps the name is not familiar; at any rate, the instrument is almost certain to be. It is neither more nor less than the well known oblong piece of card with a picture

on either side and a piece of string run through it in such a way as to facilitate its being turned rapidly round and round on its axis. When this is done the two pictures are seen to unite by the agency of the same persistence of vision commented upon by Lucretius and first exampled by Ptolemy. The present price of the Thaumatrope ranges from a halfpenny downwards. Marvellous is it to read in Hopwood's book "Living Pictures, 1899," that in the year of its inception there was something in the nature of a controversy between two eminent scientists as to which of them was the true inventor. Dr. Paris claimed it and even went further and placed it on the market at the price of seven and sixpence, but there seems to be the strong probability that the Thaumatrope is really due to the brain of Dr. Fitton, his contemporary. Be that as it may, our halfpenny spinning card remains the solitary practical 'moving picture machine' from thence onward till the year 1832. Work upon the subject of optical synthesis was done in the meantime, notably by Doctors Roget and Faraday, but only in the latter year was the Thaumatrope finally supplanted in popular estimation.

The lucky rival came into the world under somewhat strange circumstances, being invented at one and the same time by two distinct and quite independent scientists, Stampfer and Plateau. Dr. Plateau called the contrivance by the name of 'Phenakistoscope,' and by this simple and expressive cognomen it has thenceforward been known to the world. Since the Phenakistoscope marks something like a recognisable step towards our goal, it is worthy of a short description. Briefly, it consisted of a circular card around which were painted a series of figures or other devices illustrating to the best of the artist's ability the several phases of a given movement. The card was arranged to rotate upon a central shaft, and was backed by a second larger card, also rotating upon the same centre and at the same rate as the one bearing upon it the painted figures. Around the area of the larger card were cut equidistant slits corresponding in number with the figures on the smaller disc. Such is the somewhat complicated description of the Phenakistoscope, but its manner of working is at least correspondingly simple. On revolving the contrivance in front of a mirror with the eye placed behind the slotted area of the larger disc, the reflected figures were seen as though in motion. Since the present sketch is purely historical, there will be no pause here to explain the why and wherefore of the optical illusion. Such will become clear in the course of the description of the modern kinematograph projector as found later on in the body of this book.

Once again after 1832 we have to record a lengthy interval without any very notable advance in the synthesis of the motion picture, an interval broken at last by the introduction of the Zoetrope, or wheel of life.

The Zoetrope belongs to the year 1860. It was in effect a cylindrical form of the Phenakistoscope with, however, this striking difference, that instead of a mirror image being viewed, the apparently

animated figures themselves were watched through slits placed around the edge of the canister in which they revolved. And still, though by now the problem of obtaining the illusion of motion in a diagram or drawn device may be said to have been solved, it would be almost as difficult as ever to recognise in the solution a single point of resemblance to the action of a modern kinematograph.

This resemblance first became distinct in a little invention due to Mr. Beale—the Choreutoscope. But by now, history is moving apace. We have arrived at the year 1884. In the Choreutoscope we have, barring the flexible photographic film, practically every essential of the modern maltese cross machine, and this notwithstanding that the whole contrivance was designed to fit into the stage of an ordinary magic lantern. The Choreutoscope consisted of a wooden slide fitted with a ratchet arrangement in which ran a notched frame bearing a glass panel painted with designs representing the several phases—or supposed phases—of a simple movement. The turning of the ratchet handle imparted to the slide intermittent movement through the notches on its periphery, while each shift was covered during projection by the automatic rising and falling of a small drop shutter.

On placing the little instrument on the stage of the optical lantern and turning the handle, there was therefrom projected on the screen an effect somewhat similar to that previously obtained by direct vision of the original image in the Zoetrope or by the observation of the mirror image of a succession of movement phases cast by the Phenakistoscope. But still we are dealing with the creation of apparent animation in drawn or painted designs, whereas the essence of the kinematograph is that it goes to nature as revealed by means of photography for its movement analyses.

And now in order to understand the trend of events, it must be recorded that during the latter years, from the early seventies onwards, while one batch of inventors had been hard at work trying to perfect the synthesis of imaginary movement phases, such as might be culled from drawings or time-exposed photographs of models, another class of inventors had been engaged upon what must be looked upon as the totally different subject of true movement analysis. The earlier attempts in this latter direction were made through the means of photography upon glass plates, and the records of movement were obtained not as a series of single pictures but as a superposed jumble of black and white guide streaks, which might tell those in the know a great deal, but would certainly tell the average man in the street nothing whatever.

It was a great advance—something of a minor revolution in the nature of things—when in 1872 Muybridge, an American, rigged up a series of separate cameras so arranged that the shutters were released one by one upon the passage in front of them of a trotting horse. The result of the departure was a number of photographs of consecutive true movement phases which, when combined in the Phena-

kistoscope or Zoetrope, gave something approaching a complete rendering of actual motion. Thus was the first elementary success in motion photography attained. Very soon, however, the use of a series of cameras for general work was found to be impracticable for a number of reasons, and the Muybridge system accordingly came to be supplanted by the Marey system, wherein one lens only was made use of. The Marey Photographic Gun of 1876 is a case in point. It was shaped something after the style of a monster revolver and took twelve quickly successive images of a moving object, recording them upon a circular sensitive surface. Later, in 1888, appeared the first printed work upon the then newly discovered sheet celluloid as a vehicle for carrying photographic emulsions, and the year afterwards, 1889, saw the filing by Messrs. W. Friese Greene and M. Evans of the specification of their machine for taking and projecting moving photographs—the admitted father of all true kinematographs.

The Friese Greene kinematograph camera and projector utilised photographically coated strip celluloid just as do those of the present day. It was fitted with a shutter, also with an intermittent movement actuated by a spring cam, and the results obtained with it were both creditable and practical. From this point onwards, the principle of kinematography must be looked upon as solved.

The history of the subject now becomes more one of improvements than of new ideas. For this reason, as also for the sake of brevity, only two other machines will be touched upon in the present historical preface. One of them is the kinematograph of Donisthorpe and Crofts, patented August 1889, and worthy of special mention as being the earliest representative of the loopless camera.

The last camera of all to be mentioned here among the antiques is the 'Lumiere Cinematographe,' introduced in 1895. This was a pin or claw camera and projector. So accurate and reliable did its performance prove that very soon it found its way to a London music hall as a star attraction, and thereupon was inaugurated the living picture craze, a craze which seems as far from dying down as ever it did—perhaps farther, as instance the following, written by Mr. Cecil M. Hepworth in the year 1897:

> "That the kinematograph has contributed much to the "gaiety of nations can hardly be denied, but that it will con- "tinue to do so to anything like the same extent for much "longer is most improbable."

The above is an excellent instance of the futility of prophecy in the kinematograph world. But of the 'Lumiere Cinematographe'? How has that particular machine fared in the melting pot of time? Well, how should it fare? It has gone, of course, like all its contemporaries.

But a few months since, the writer had occasion to invest in a kinematograph camera of the very latest type. It was an excellent and an expensive instrument, so new in design that the very patent

specification on which it was built was hardly emerged from the government printing press. *And on opening the front panel and looking at the newly patented works, they were found to be in all essentials identical with those of the defunct Lumiere machine.*

Thus, briefly, we have the history of the kinematograph—a history of development and improvement which has ultimately resulted in a scientific entertainment, the like of which has never been enjoyed and witnessed by the people of the whole world, the possibilities of which we can barely imagine, which gives employment to thousands and enjoyment to millions daily, and which amuses, educates, and brings into closer relationship the inhabitants of every quarter of the globe.

Some of the First Subjects
ever photographed for
Living Pictures.

One of the Pioneers — Mr. W. Friese Greene.

PART I.

Kinematography.

CHAPTER I.

THE PHOTOGRAPHIC PRINCIPLE.

Kinematographic photography is best led up to by a brief survey of the principles of photographic picture making in general. Indeed, between it and ordinary snap-shot work there is but one small difference, that whereas the latter takes a single instantaneous photograph at a time and has done with it, the former takes a succession of them at such quick intervals, one after the other, that each second suffices for the making of roughly sixteen complete photographic records.

For the purpose of subsequent projection upon a screen by means of a moving picture projector, it has, moreover, been found necessary that the kinematograph camera should make its multiple records upon a long roll of emulsion-coated celluloid ribbon, while the hand camera makes its single one upon either a glass plate (the technical term for an oblong piece of photographically coated glass) or else upon a comparatively short length of wide celluloid sheet of a like shape. Thus we early arrive at the conclusion that the only vital difference between the moving picture recording machine and the ordinary snap-shot camera is in the quantity and speed with which the views are taken.

Let us then first turn to the consideration of the principle of cameras in general.

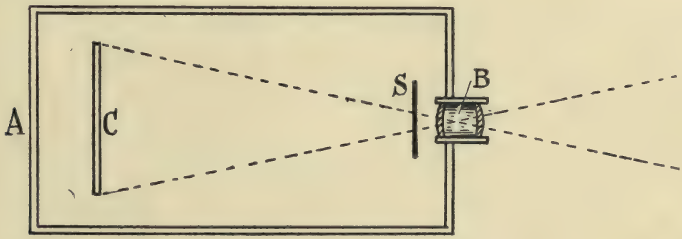


FIG. 1.

Fig. 1 represents a diagrammatic view of the arrangement of an ordinary hand camera. A, A, A are the sides of the familiar box in which the photographic plate is enclosed. This box is made light

tight except for the hole occupied by the lens B, through the glass of which light may be admitted upon the surface of the prepared plate C, or may be shut off by the interposition of a shutter S at the will of the photographer. Normally, this shutter is in its light stopping position as represented. Only when the photograph is to be taken is a spring set in motion by which the shutter is switched out of the way of the lens for the small part of a second, during which time light is consequently allowed to stream in through B upon the sensitive surface at C. Such is a brief sketch of the working of a hand camera.

Let us next turn to the consideration of the nature of the sensitive coating upon the plate C, the function of which is to become affected or, as it is called 'exposed' by the light action. Briefly, C is a piece of sheet glass which has been coated in the dark with gelatine containing in it the chemical known as silver bromide. This sensitive coating or 'emulsion,' has before exposure to daylight a pale milky yellow appearance, and the same is not altered even by exposing the plate to daylight for a minute or more at a time. Even a very short exposure has, however, the effect of bringing about in the emulsion a sort of secret change, which, although not discernible in itself, becomes evident enough on treating the plate with a special chemical solution known as a 'developer.' Suppose a photographic plate to have been taken out of its light tight box in which it is supplied by the makers and to have been put into the camera in darkness (or by a special red 'dark room light,' so called because a deep shade of this colour is without the action about to be ascribed to daylight); suppose the camera has been thus 'loaded,' and that it is now taken out into the open and the shutter S allowed to flick for a moment out of the way of the lens so that light may stream for a brief instant upon the plate. Now we will take the camera back to the same 'dark room,' withdraw the 'exposed' plate and place it in a dish filled with 'developer.' What will happen?

Very soon we shall notice a strange change come over the milky whiteness of the 'emulsion.' It will turn darker and darker in degree as the lens has cast more or less light upon it. If we go on long enough, and supposing the exposure has been sufficient, we shall end by getting the plate quite black in parts.

This blackness is caused by the developer having 'reduced' the silver bromide to a deposit of finely divided metallic silver, which remains held to the glass in its matrix of gelatine.

Suppose that our developed plate is in fact what it should be—a satisfactory photographic negative, we shall also notice that the blackness produced upon it by the developer is not of equal degree all over its face. Some parts may even still be of the old milky white hue. We now rinse off the developing solution and apply another one known as the 'fixer.' Here the remaining whiteness entirely leaves the gelatine. The negative is from this moment complete, except for the need of a good washing under the tap to free it of chemicals. Suppose we take it out into daylight, to which it has by this time

ceased to be in any way responsive, it will be found that where the milkiness remained to the last before fixing, there will be nothing left afterwards but colourless gelatine. Over other parts of the glass surface will be a cloud of varying opacity, consisting of the metallic silver deposited by development, and the finely divided state of which causes it to appear without any metallic lustre, and merely as a grey-black dull veil upon the plate.

But we shall notice something more also, provided the camera lens was in focus. It will be seen that the silver deposit has formed itself into a sort of replica in black and white of the scene toward which the lens was pointed at the moment when the shutter was 'released.' Why is that?

This brings us to the consideration of the one remaining important part of the single picture camera—the lens. The lens is the camera's eye and as such performs for it much the same function as our own eyes do in our heads. Long ago it was discovered that a piece of glass ground to a sphere, or portion of a sphere, would throw some sort of a reflection or 'image' of real objects before it. Doubt less the first of these images to be formed in practice was the sun's disc. The spot of light formed by the mischievous boy's burning glass is in reality nothing more nor less than a well shaped 'focussed' image of the sun thrown upon a suitably combustible substance with the avowed intention of utilising the heat rays concentrated together with the light rays for the purpose of bringing about a conflagration. But though the sun is the easiest object to get a visible image of by means of a lens, since it is so bright that such can be seen and focussed in full daylight, yet all other objects throw images in precisely the same way if the light reflected from their surfaces is similarly "brought to a focus." Moreover, these images are made visible at once by the simple process of screening off extraneous light, which would otherwise obscure the comparatively dim evidence of their formation.

Hence we arrive at the general arrangement of the hand camera as shown in fig. 1.

The surface of the plate actually gets thrown upon it at the moment of exposure a real picture or 'image' of the actual objects in front of the camera. Since some of these outside objects are naturally darker than others, it will follow that subsequent development of the plate will bring about a silver deposit of variable density according to whether the amount of light action has been great or little at any particular point. So do we produce the 'negative,' or black and white record upon glass, of the object photographed, upon which record the whole basis of practical photography rests, and from which 'negative' the 'positive' or regular photograph is obtained by a process known as 'printing,' of which more in Chapter 8.

That the image thrown by a lens upon the sensitive surface is in fact a real one is very easily proved by removing the back of the camera and substituting in place of the sensitive plate a piece of finely

ground glass. If, then, the shutter be opened so as not to impede the light, a picture of all objects before the camera will be seen upon the ground glass in the form of a coloured and inverted image. The inversion of the picture is got over in practice by the extremely simple expedient of righting the negative when using. There is no simple way, however, of obtaining a record of the colours thrown by the lens. For present purposes, therefore, these must be neglected.

A brief semi-technical description of the action of a lens appears in the appendix to this part.

We have now mentioned the three fundamental parts of a still picture camera, namely, the sensitive plate, the light tight box surrounding it, and the lens. Let us hope that from the consideration of these, we have also grasped something at least of the underlying principle of photography as such. It remains for us to go a step further and examine the one additional contrivance by which what would otherwise be a still picture camera is turned into a moving picture recorder. This contrivance may take various forms, all of them intended to accomplish the same purpose—the moving onward, jerk by jerk, behind the lens, of a band of photographically coated celluloid so that this same coated band may play the part of a rapidly replaced succession of 'plates,' for the quick recording of negative after negative at the rate of approximately sixteen pictures per second.

The contrivance which imparts to the film band its above mentioned jerky movement, and which is possessed only by kinematograph cameras, thereby differentiating them from those of the single 'still picture' variety, is known as the 'escapement,' or intermittent mechanism.

A Picture Show Proprietor in the Far East.

CHAPTER II.

THE KINEMATOGRAPH CAMERA.

Granted we have contained in our kinematograph camera a sufficient length of the ribbon like film to be photographed upon, there are two main problems to be faced in the manner of applying the required intermittent motion to it. First, we must provide the motion with a satisfactory grip upon the film stock. Then there will be the matter of arranging the mechanism of the camera so as to pull down the film an amount corresponding with the height of one picture sixteen times a second for so long as it is in operation. The way of making film stock capable of being easily gripped is by 'perforating,' or punching small holes in its edges at intervals.

Unperforated film stock looks like a plain milky white coated length of celluloid ribbon, whereas when perforated, the apertures are plainly seen running along its edges as in fig. 2. Once these perforations have been made, it is easy to see that the task of getting a grip upon the film for its intermittent movement is immensely simplified. Neither is it difficult for the mind to conceive that such is probably accomplished by a species of hooking action.

FIG. 2.

The form of hook actually employed in the intermittent movement or escapement of kinematograph cameras is called by the various names of 'pin' or 'claw.' They both really mean the same thing, except, perhaps, to the straw-splitting mind. The following diagram is intended at one and the same time to give the reader a fair idea of the internal arrangement of a motion picture camera and to explain simply the hook, pin, or claw action upon which in some form the mechanism almost always depends.

Fig. 3 shows an excellent and simple type of present day motion picture camera with the film threaded as it would be during use. This film will be seen to emerge through a light trap in the outer bottom corner of the upper film box. From thence it passes between an upper 'sprocket' (a 'sprocket' or sprocket wheel being a wheel cut with a double row of blunt spurs or teeth to fit into the film's perforations) and an 'idler,' B. The function of the idler is merely to keep the film fed against the top sprocket, which moves at

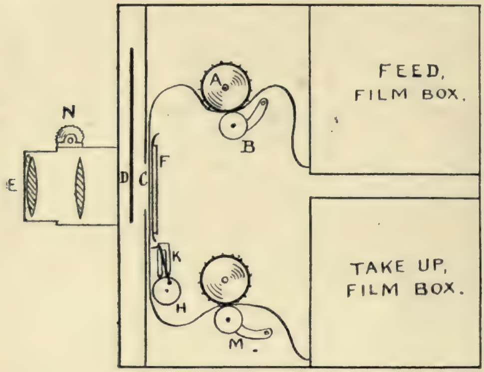


FIG. 3.

a constant rate on turning the camera handle (not shown in the diagram), and so causes the sensitive stock to move from the upper film box.

A moment's thought will show that if this were the only moving part in the camera, the result of it would be merely to wind the whole of the sensitive film out of the film box into the body of the instrument without accomplishing anything else. As a matter of fact, nothing of the sort happens. And that brings us to the consideration of the escapement itself.

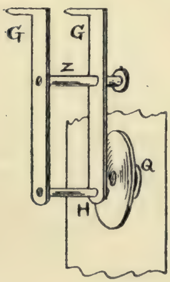


FIG. 4.

This will be found figured just below the gate runners F. G is a double bar made of finely tempered steel (see fig. 4). It is pivotted eccentrically upon the revolving skeleton drum H (fig. 3), also shown larger in fig. 4. This skeleton drum, is like the sprocket wheel, caused to turn at a uniform rate by operating the camera handle. But as it revolves, it will have the effect of turning the double hook arms G not round and round with it but more or less up and down in a track which is further governed and made definite by the cam K, shown in fig. 5. This cam has in it a groove of just the right size to accommodate the roller-encased bar Z (fig. 4).

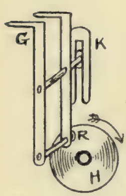


FIG. 5.

But to go into this last more carefully: Look at fig. 5 once again and we will ask ourselves what is the effect of revolving the drum H in the direction of the arrow. It will be plain that such rotation would have the effect of pulling the pivot R of the arm G to the right and downwards. This would throw the hooks on the end of G toward the film stock, since the roller bar held in the cam is converting G into a lever. Imagine that the amount of sideways throw is just sufficient to cause the hooks to become firmly engaged with the nearest perforations before such motion is counterbalanced by the downward thrust brought about by the continued rotation of H. We now have the film firmly gripped by its perforations and in a state of being pulled rapidly downward. Such movement will be continued until the movement of R to the left again, as it nears the lowermost extent of its travel, causes G to swing to the right, leaving

the film free. Once that phase has come about, the film's movement naturally stops dead and remains so for approximately one half a revolution of H, by which time the point R has come up again, and into position for the repetition of the whole cycle.

Here then we have practically realised the required intermittent motion required by the exigencies of kinematography. All that now remains to be done is to take up the slack film as it is passed through the gate C, behind the camera lens E, and shutter D. This taking up of slack is accomplished by the second sprocket and idler LM which are like the top ones geared to move continuously. The final winding up of the exposed film is accomplished by leading it through a light trap into the take-up box, where a spring attachment holds it to a revolving bobbin.

So much for the description of one of the typical modern camera escapements. It may fairly be said that once the above action has been grasped, the numerous variations of the claw or pin movement found in cameras of different makes should furnish no real difficulty to the mechanically minded photographer. But still, there are several points about the motion picture camera which have so far gone undescribed, notably the camera shutter, the take-up mechanism, the arrangement of the gate, and the gearing whereby the necessary motion is imparted to the whole mechanism on turning the camera handle.

The 'gate' of a motion picture camera consists fundamentally of two parts; the picture mask proper and a spring plate so arranged as to press the film upon it, thus holding it firm and flat after each period of travel. Camera gates look different in various instruments. They may have their own ways of opening and closing when film has to be 'threaded.' Also the pressure springs and 'runners' by which the film is kept tight against the mask may be differently arranged and have different modes of adjustment. But all gates are the same in principle and fulfil exactly the same purpose. They all need most careful attention by the camera man at frequent intervals, and all give speedy evidence of neglect by a host of imperfections arising in the negatives taken with their help. Chief among such defects are scratches and breakages, to say nothing of unsteady pictures, all of which follow as the necessary result of a dirty gate mask or runners, or of wrong adjustment of spring tension. In fact, without going too far, it may well be said that nine-tenths of the difficulties encountered by the camera man in connection with his apparatus will be mixed up with the gate. Camera gate springs, runners, and mask are best kept clean by rubbing with the end of a clean oblong piece of typewriting eraser, after which the cleaned parts should be carefully wiped with a very slightly oily rag.

Let us now to the shutter and its mechanism.

The shutter of a kinematograph camera is of a gratifyingly simple kind. It consists of a sector of a circle of light metal placed upon the end of a shaft so geared as to cause the metal blade to revolve one whole turn for each picture shift. The blade is timed to come in the track

of the lens, thus intercepting the light rays, whenever the escapement comes into operation to shift the film downwards. At other times, the image thrown by the lens is allowed to reach the film unobscured.

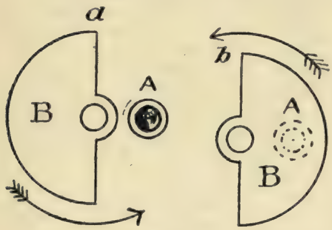


Fig. 6.

Fig. 6 gives a diagrammatic idea of the relative position of lens and shutter as seen from a point of view in front of a skeleton camera: A the lens, B the shutter; (a) represents the position of the sector during exposure of the film in the gate, while (b) represents the position of shutter at time of picture shift. For the sake of clearness, arrows are included showing the plane of rotation of the shutter.

In practice, the shutter of a motion picture camera instead of being made solid as represented in fig. 6, is generally composed of two pieces which can be set to overlap one another till they assume the same form as that already depicted, or may be drawn apart, so as to narrow down the cut-away portion of the metallic light obscuring circle as in fig. 7, thus giving the photographer an additional power over his instrument. How this power is taken advantage of in practice will be gone into later on. In looking after the shutter of a motion picture camera, the great thing is to see that the gearing which drives the shaft is kept well oiled with not too thin an oil, that the shutter blades themselves remain dead black and do do not become bent, and that the sectors are quite firm in their bush. A tin of some high quality photographic dead black should always be kept handy for going over the shutter blades and front of the picture mask. The reason of the presence of the shutter in a kinematograph camera is one which will be apparent to every photographer. Were it not for its function of 'capping the lens' during each picture change, the movement of the film would cause the sky portion of each negative to fog the foreground, while all bright objects of small size would appear on the film negative with comet-like tails of fog proceeding upwards and downwards from them.

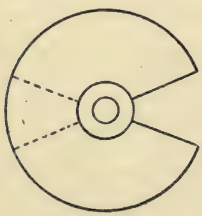


Fig. 7.

The reason of the 'take-up' has already been explained. It only remains to make clear how its effect is brought about. Each film box is provided in its interior with a revolving bobbin connected through a light-tight bushing with a rotating plate on the outside of the back of the box. The face of this plate is provided with studs to engage with an independent bar connected with a friction-clutch driven by the camera handle. All that is necessary, therefore, when using a film box as a take-up is to pass the end of the film (previously threaded through the gate and lower sprocket unit) through the light trap in the box's corner, and then connect it firmly with the bobbin by means

of a suitable spring clip. The constantly rotating bar driving through the friction clutch in the camera's mechanism does the rest.

And now to the nature of that mechanism itself. In most cameras of ordinary type it is to be got at by opening a door on the right hand or opposite side of the camera to that giving access to the film and escapement. Broadly speaking, it will be found to include a main gear wheel mounted on a suitable frame and capable of being expeditiously connected with the moveable camera handle. This main wheel transmits power to the five principal camera motions either through a train of spur wheels or by a mixture of spur wheel and chain drive. Spring bands are often employed for connecting the take-up. Power has to be transmitted somehow to top sprocket, shutter, escapement, bottom sprocket and take-up, and it is important that the camera man should not content himself merely with mastering his machine as revealed through the left-hand door, but should also make himself thoroughly acquainted with the nature and function of every wheel and piece of gearing hidden behind the right-hand one as well. This will have to be done principally by the use of his own common sense, since in hardly any two cameras is the arrangement for the driving gear of the various motions exactly similar. At the same time, it is only by mastering the meaning of each chain and spur wheel that the photographer is in a position to guess the meaning of any suspicious 'grind,' which may from time to time strike upon his ear, and to know how to put it right forthwith.

Such then is a brief dissertation on the bare bones of the moving picture camera. There are, of course, several important parts of the instrument which have been never so much as touched upon in the foregoing. For instance, nothing so far has been said upon the arrangements for, or methods of focussing. Then again, motion picture cameras are fitted with various quite important, though subsidiary, devices without which their use would be very much a matter of hit and miss. Under such heads might be classed film recorders for registering the number of feet of sensitive film stock consumed when taking any given subject, view finders, and the like. But the place of such may well come in the next and succeeding chapters. The tripod is also a most important feature of the kinematograph photographer's kit which will be dealt with hereafter.

What we have tried to do for the present is to describe the essentials of motion picture taking apparatus just sufficiently to enable the reader to bring an intelligent mind to bear upon the more particular descriptions of different makers' instruments which follow.

CHAPTER III.

THE CHOICE OF CAMERA KIT.

Before we can go to the practical side of handling motion picture apparatus, it will be necessary to see about purchasing the apparatus itself. Only when we decide on the particular camera, tripod, or whatever it may be, we contemplate using, shall we be in a position to thrash out the many minor details of manipulation which distinguish it from other and slightly differing models on the market. Thus, to take the motion picture camera as a start, our particular one may be furnished with two sprockets, or it may have only one. It may possess outside film boxes (though these are now pretty nearly obsolete), or it may be fitted with the more modern inside ones. It may have focussing from the front or the back of the camera. In fact, a motion picture camera is, in its way, quite an individuality. Let us pass from the abstract to the concrete, and examine the individualities of some of those most worthy of our attention.

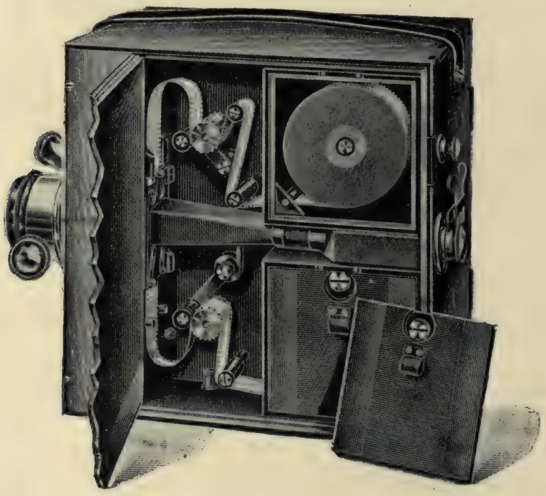


FIG. 8.—SECTIONAL VIEW OF LOADED CAMERA.

For the extremely moderate sum of £8 10s., Messrs. Butcher and Sons supply their Empire Camera No. 1. This is a useful little instrument of the single sprocket variety, having inside film boxes of 120

feet capacity. It is fitted with a Voigtlander Collinear lens, and will be found an admirable little instrument for the amateur or learner, as also for the picture theatre manager wishful to turn out his own short length local topicals. Fig. 8 shows the Empire Camera No 2, put out by the same firm. This is a regular professional instrument. It has film boxes of 165 feet capacity, and a Zeiss Tessor lens working at F6.3. Focussing is from the front and also from the back of camera. There is a film indicator to show number of feet used on any given subject, and altogether the camera is a thoroughly efficient one.

THE WALTURDAW

Fig. 9.—A Camera Closed for Use.

Needless to say, where a professional type of instrument is required, cost must always be reckoned as subservient to solidity and accuracy of construction. A camera combining moderation of price with many expecially valuable features is supplied by Messrs. Walturdaw, the name of this firm being also a household word in the trade. We append an illustration of this Walturdaw D model patent Bioscope Camera (fig. 9). Though this particular picture does not show the camera's interior, it may be taken for granted by the reader all's well within as well as without. The claw movement is of the best, bush-

ings being specially hardened, and the whole tested to the point of absolute unswerving reliability. The Walturdaw camera also boasts what the last did not, namely, a feet film indicator, so essential both in general, and even more particularly in trick work. The two lower bosses shown on the camera's side are respectively the handle connections for reversing and speeding down, both of which matters will be found described further on in the chapter on trick kinematography. The lens also possesses accurate means of focussing, while inspection of the focussed image is through a tube extending from the camera gate to the back of the instrument.

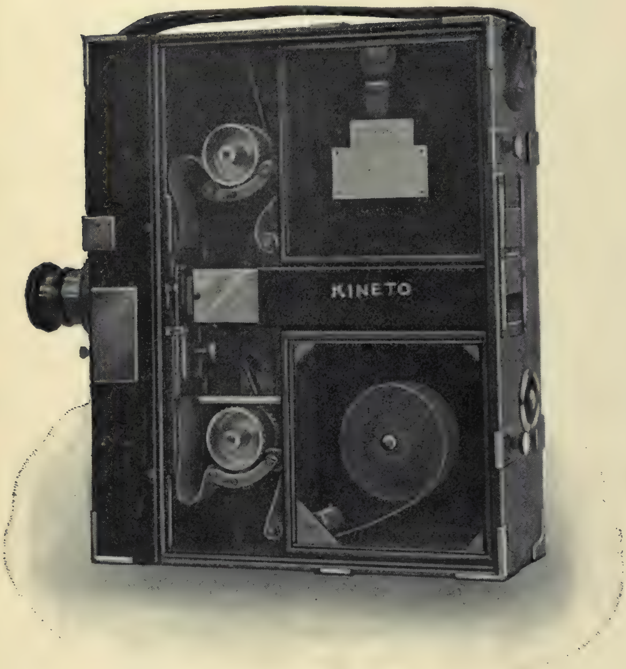


FIG. 10.—ANOTHER POPULAR CAMERA.

FIG. 11.

THE CAMERA SHUTTER.

Perhaps this focussing tube arrangement will be better understood by reference to the next illustration, that of the Kineto camera (manufactured under Moy and Bastie's patents). Here the tube will be seen to be situate between the two film boxes. It may be recognised as that portion of the instrument on which the block maker has engraved the name 'Kineto.' Looking carefully at the camera back, one sees a door partially open, and through which, on looking through the aperture and up the length of this tunnel-shaped tube, sight of the gate

can be obtained for focussing purposes. This same illustration will give us an excellent idea of the mode of threading up the film in a high grade camera. The unexposed roll has been previously placed in the topmost film box. The projecting end will then be seen to pass between the jockey rollers and the topmost or feed sprocket of the camera, down through the gate and back into the take-up box over the sprockets of the take-up sprocket wheel. The whole system of threading is, however, shown much plainer in the illustration than

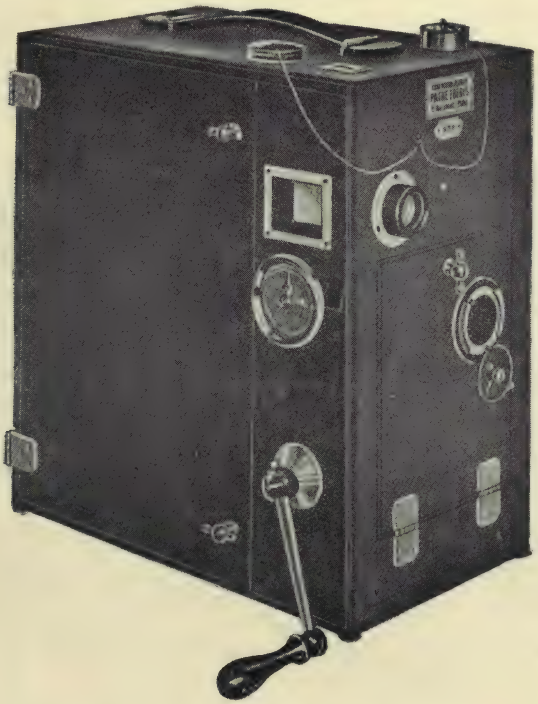


FIG. 12.—EXTERIOR OF PATHÉ CAMERA.

any verbal description could make it. The Kineto camera, besides being provided with all the advantageous movements and attachments common to high grade picture taking instruments in general, boasts many features quite its own, all of them tending toward the greatest perfection in kinematograph photography. Thus, the shutter is of very light construction, and of very variable aperture (see illustration 11)., also the escapement, while conforming in general with the prin-

ciple of the claw, is exquisitely constructed upon a system reminiscent of the old Lumiere movement, which for sheer unerring accuracy, has never yet been surpassed either in camera or projector. The lens fitted to the Kineto camera (failing contrary orders) is a Zeiss Tessar, working at the extremely wide aperture of F3.5, and supplied in a helicoidal focussing mount, which renders the operation of focussing

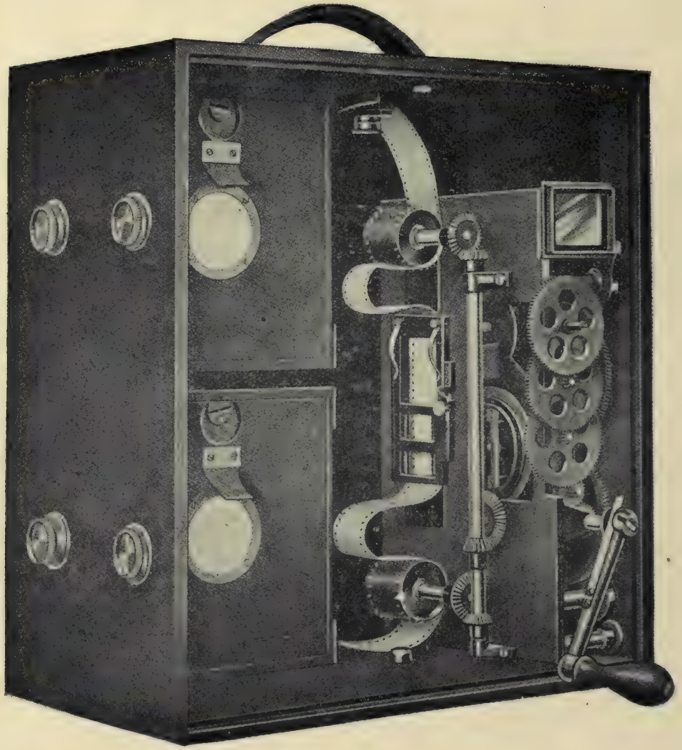


FIG. 13.—WORKING PARTS OF PATHÉ CAMERA.

—as also of scaling the lens when so required—one of extreme ease. The Kineto camera is therefore a most perfect instrument, but it is not low in price; neither is the Pathé camera, illustrated in Figs. 12 and 13.

Fig. 12 gives a general view of the camera as seen by the man in the street. Here we note that a strong point in its favour is its simi-

larity in general appearance to a rather large snap-shot camera. Where ostentation may prove a disadvantage, as is by no means seldom the case, the above points may tell heavily towards the kinematographer's success. The handle, however, must always give away the moving picture man to those even a little in the know. Fig. 13 should set at rest all our doubts as to the Pathé camera being really

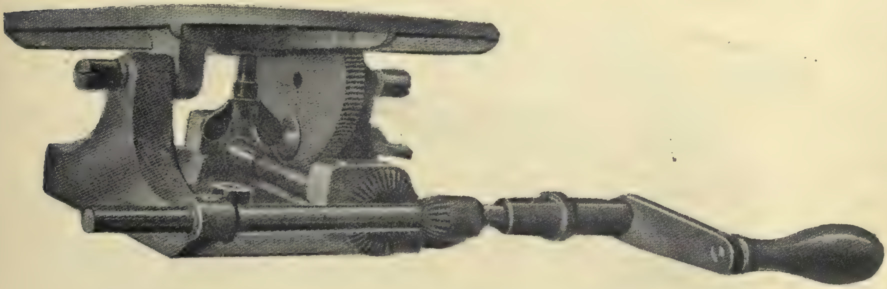


FIG 14.—WRENCH REVOLVING TRIPOD HEAD WITH TILTING TABLE.

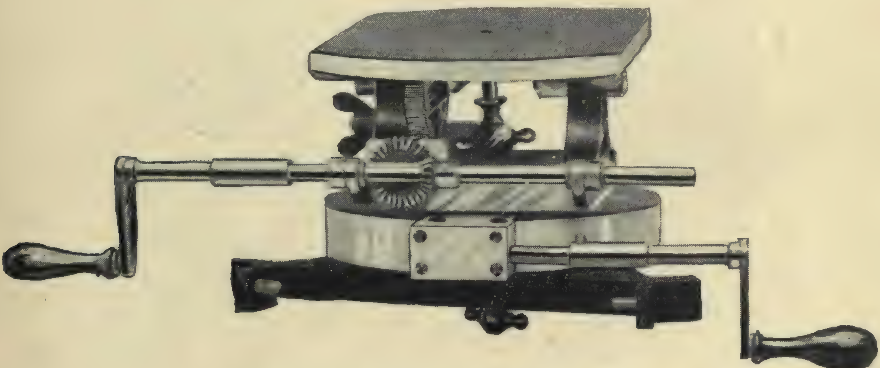


FIG. 15.—A COMPLICATED TRIPOD HEAD.

of the ordinary snap-shot variety. Instead, we see its interior to be fairly seething with machinery, all of it, be it said, of the most accurate and beautifully finished description. Messrs. Pathé's long-lived reputation for having everything of the best should alone be enough guarantee for us in this respect. In the Pathé camera also, the claw movement is modelled largely according to the old Lumiere model, wherein the distinguishing feature is that the pins of the escapement mechanism strike down and up in a rectangular path, their grip or

otherwise upon the film perforations being controlled by a second movement which shoots them in and out automatically after the manner of bolts. In common with most other high grade cameras, the Pathé one has film boxes of large capacity, thus admitting of the continuous photographing of incidents extending over upwards of seven minutes at a time. So much then, for kinematograph cameras in general and in particular. We have glanced at models ranging

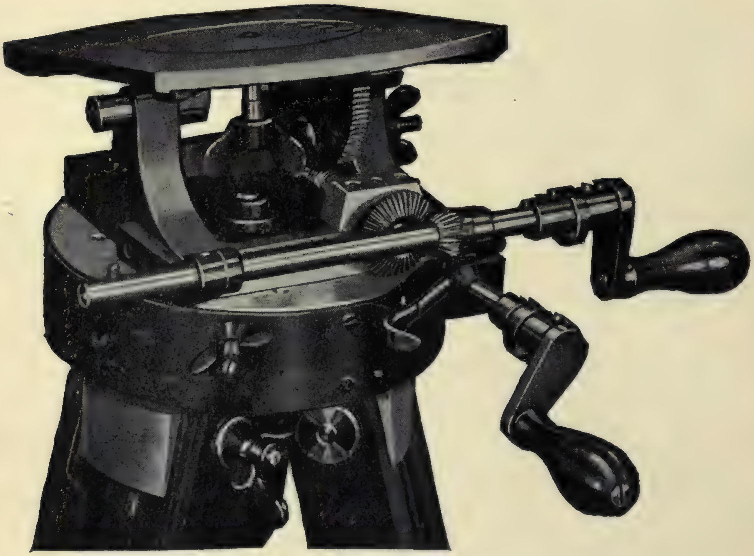


FIG. 16.—ANOTHER TYPE OF TRIPOD HEAD.

in price from the inside of a ten pound note complete with tripod, to over fifty pounds. And that last remark about the tripod leads on insensibly to consideration of this absolutely indispensable part of the motion picture man's equipment.

Tripods for motion picture work differ from those used in still view photography chiefly on two points, one being their weight—fourteen to sixteen pounds is very moderate for a kinematograph tripod —and the other the presence of mechanical turning movements in the tripod head. Figs. 14 and 15 illustrate two forms of mechanical tripod heads, the first from those excellent makers of apparatus, Wrench and Son, and the other from Pathé Frères. The simpler one, possessing only one handle, is what is known as a 'panoram' head. In this case, the table top surface upon which the camera is bolted, can be made to revolve slowly round and round in either direction, by virtue of turning the actuating handle to or from the operator.

The more complicated tripod head possesses beyond this panoram action, a second camera tilting device, also worked by a handle-turning attachment, and sometimes referred to as a 'maxim' movement, from the similarity between it and the elevating mechanism of the Maxim gun. The Maxim attachment is very convenient at all times,

FIG. 17.

TRIPOD WITH HEAD ATTACHED.

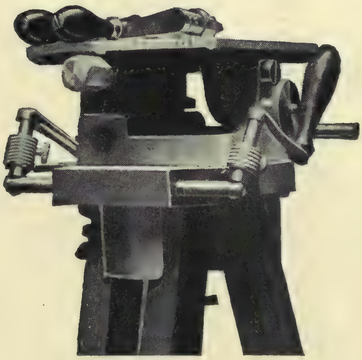


FIG. 18.

CAMERA HEAD, SHOWING HANDLES CLOSED.

and especially where it is desired to obtain a wide panorama of objects above or beneath the camera level. In fact, without it, such slanting panoramic attempts are sure to show a tipping of the horizon at some point or other in the resulting picture. Illustration 16 gives another close view of the combined revolving and tilting head as fitted to one of Messrs. Butcher's motion picture tripods.

On page 17, we see the same applied to the Walturdaw tripod. This tripod, it should be added, has the special advantages of lightness (it is not more than fourteen pounds weight all told), portability, and a most reasonable price. It is, moreover, fitted with handles which fold up after use, instead of having to be removed, the latter course often leading to the omission from the working kit of one or other of the tripod handles at a time when it is most required. The writer speaks feelingly on the point, having before now been seriously handicapped through just this catastrophe brought about by a simple failure of memory.

In the matter of the view finder, most field operators will agree that something of the kind should be attached or attachable to the motion picture camera, for use when photographing topicals, fast moving objects, and under conditions of general hurry and excitement. Otherwise, there is great liability for there to be needless waste of film stock by starting the handle too early, and continuing turning after the point is reached when the photographic record ceases to be useful. At the same time, by no means all operators are agreed as to the best form of finder to employ. Some make use of a simple hollow rectangular tube or frame affixed to the camera body in such a position that, by looking through it, a more or less correct idea of the picture field is obtained by simple direct vision, unaided by any form of optical lens system whatever. Probably, the far better course for the budding camera operator will be to make his choice of a view finder from one or two well-known and recognised models. Either let it be a finder of the kind consisting of a rectangular conclave lens, behind which is fixed a central sighting bead, after the manner of a military gun sight, or let it be a finder of the box form type, in which a front convex lens throws a real image of the scene to be taken upon a ground glass screen at the rear of the finder box. View finders of both types are stocked by all makers of and dealers in motion picture cameras.

And now a word as to the motion picture taking lens. It has been said already, kinematograph cameras are usually supplied ready fitted with a suitable lens, but, though this is true, several makers require the purchaser to make his choice from amongst two or three alternative ones specified on their lists. For this reason, we append illustrations of some of those instruments best known and best suited to the work in hand. And here let us say that for ordinary purposes, the focus of a kinematograph lens should be anything between two inches and three and a half inches, the shorter focus being generally most useful for topical filming in restricted situations, and the longer for scenic and artistic work, where there is plenty of elbow room at the camera man's command.

Illustration 19 is of a Zeiss Tessar lens. This lens works at F3.5, at which extra wide aperture, it gives critically sharp definition over

SOME OF THE BEST CAMERA LENSES.

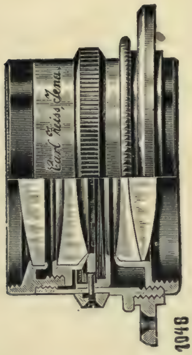


FIG. 19.—ZEISS TESSAR LENS.

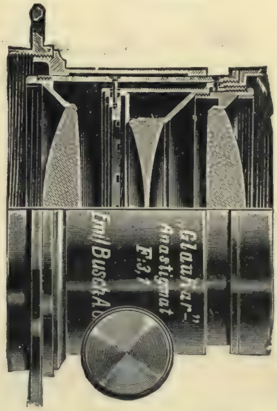


FIG. 20.—BUSCH GLAUKAR LENS.

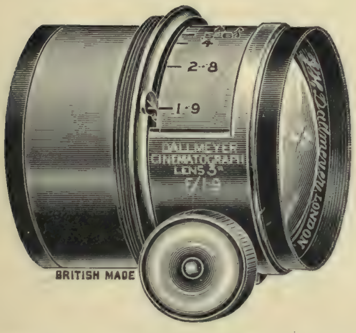


FIG. 21.—DALLMEYER F/1-9 LENS.

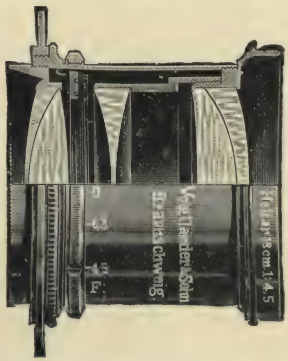


FIG. 22.—VOIGTLANDER HELIAR LENS.

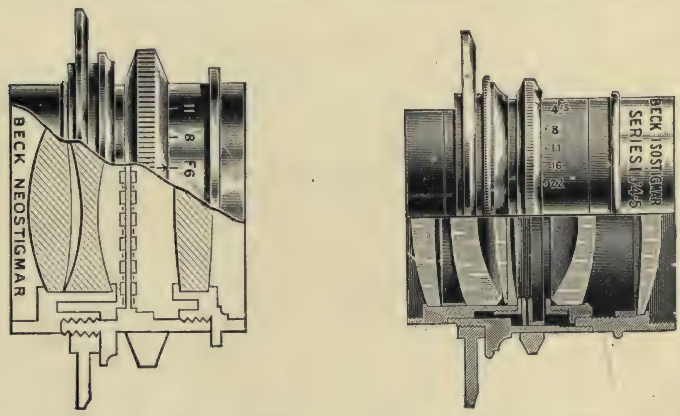


FIG. 23.—BECK NEOSTIGMAR AND ISOSTIGMAR LENSES.

the whole area of the kinematograph film picture. More than this we need not say of it, for its suitability for the work in question is a matter of universal acceptance.

Illustration 20 shows another lens still newer in design, and wider of aperture (that is to say, more rapid) than the Tessar. This is the Busch Glaukar at F3.1. Although quite a newcomer into the kinematograph field, the Glaukar is well spoken of, whilst its great rapidity, coupled with the name of the firm producing it—the Emil Busch Optical Company—should assure for it a triumphal future. In the succeeding lens, however, the matter of rapidity is still further brought in evidence. Indeed, in the No. 2 Dallmeyer Kinematograph Lens, we have speed at what is for the present its absolute high water mark as regards motion picture making. The illustration (21), gives an idea of this lens, which, however, is necessarily a somewhat massive instrument, the result of its prodigious aperture.

For working under the most adverse conditions of lighting, this lens is quite pre-eminent, and we are particularly glad to say so, and in so doing give the palm for combined speed and excellence to an English firm, with a half century of solid British standing behind it. At the same time, the Dallmeyer No. 2 is a special lens for special purposes. For normal working conditions, its rapidity is quite uncalled for, so that it will be well for us to bear in mind the same firm also supply other excellent lenses for the picture man who may not be in pursuit of an ultra-speedy—and consequently weighty, delicate and rather expensive—objective.

To finish up the matter of lenses, we figure two other well known types, namely the Heliar of Messrs. Voigtlander and Sohn, and the Isostigmar of Messrs. Beck. (Illustrations 22 and 23.)

The former of these two lenses has a great popularity both in England and on the Continent as a medium rapid kinematograph lens, rendering pictures of absolutely irreproachable definition and good apparent depth of focus. Its aperture is F4.5. This is also the aperture of the Isostigmar, but here the claim to recognition is somewhat different, inasmuch as the latter lens is notable as being the commercial expression of a completely new idea in optical formulae. Perhaps, however, to the purchaser, another and even more pressing point of excellence in the Isostigmar may be found in its extreme moderation of price. We will only add that it is in all ways every bit as good as any other lens here mentioned.

The present would seem to be the place to touch briefly upon the subject of film perforating machines. As has already been explained, the action of the kinematograph escapement upon the film depends upon its first having been perforated with a series of extremely accurately spaced and sized holes near either edge of the film stock. The making of these holes or perforations will be readily appreciated as a task involving the most precise of mechanical contrivances, since upon absolute freedom from error depends the ultimate steadiness of the projected moving picture, as seen by the public on the theatre screen. Moreover,

extremely delicate and accurate machinery cannot, of its nature, be cheap to buy. Below we figure the Williamson perforator known technically as a 'step by step' machine, the older rotary pattern perforators being now quite obsolete. For further particulars of the step by step principle, as applied to kinematograph machinery, see the chapter on film printers and positive printing.

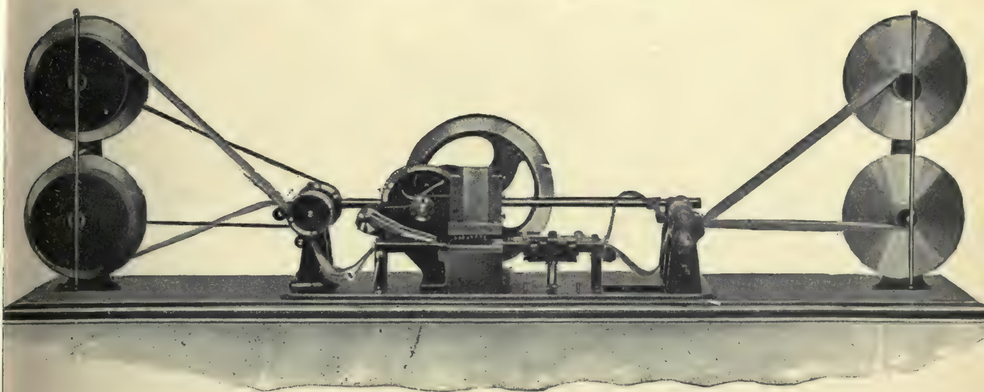


FIG. 24.—WILLIAMSON FILM PERFORATOR.

The Williamson perforator is a beautiful little machine, comparatively inexpensive and highly efficient. It can be driven by hand or motor power, and perforates two films at a time, face to face. Since film stock is perforated unexposed, at which time it is highly light-sensitive, those with some experience of photographic matters will at once realise the necessity of perforating under strict 'dark room

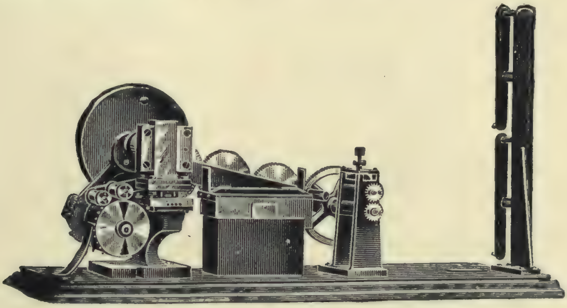


FIG 25.—EMPIRE FILM PERFORATOR.

conditions.' Others will probably buy their first few rolls of film stock ready perforated, leaving the business of doing this at home till the time when they will be a trifle more expert in the handling of the sensitive film rolls. Another perforator of excellent accuracy and great moderation of price is the Empire perforator of Messrs. Butcher (Fig. 25).

It sells at £30, a lot of money perhaps, but a mere bagatelle compared to the price of some perforators. The Empire is a splendid little instrument. Those who are determined to 'hang the expense,' may be interested in the accompanying illustration of the Debrie perforator. The firm of Debrie, it may be said, has its headquarters in Paris, and has for years led the way in the matter of sumptious motion picture apparatus of all descriptions.

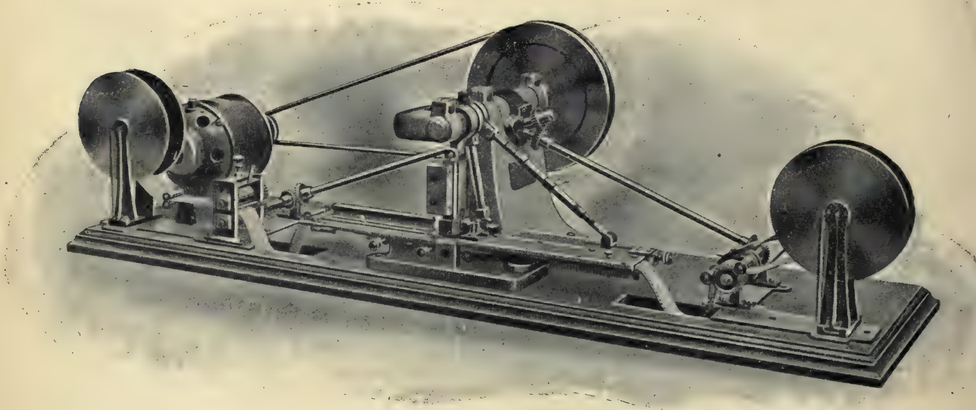


FIG. 26.—DEBRIE FILM PERFORATOR.

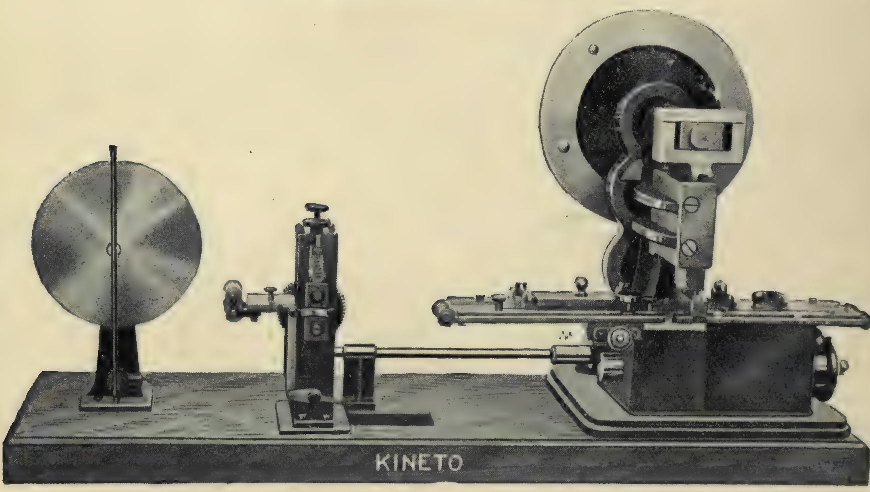


FIG. 27.—KINETO FILM PERFORATOR.

We complete the list of perforators we can recommend whole heartedly with an illustration of the Kineto machine. As in all matters

connected with the name of the firm, there is nothing of the cheap and nasty about it. On the other hand, it combines elegance with 'doing the work,' and this in the most complete way possible.

Our next illustration (Fig. 28) is of a little film perforation gauge made by the firm of Debrie. It will be seen to consist of a number of

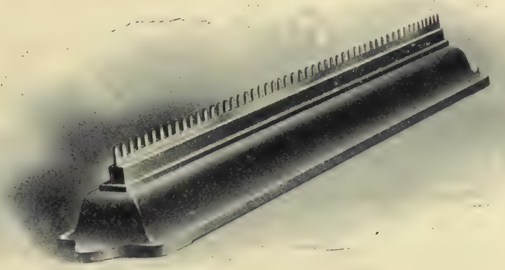


FIG. 28. DEBRIE PERFORATION GAUGE.

accurately cut metal teeth so spaced that by applying them to the perforation holes of a correctly perforated film, complete and perfect registration will result. Another excellent way of testing perforations without any special appliance whatever, is to double a length of the film over itself at a point midway between two perforation holes,

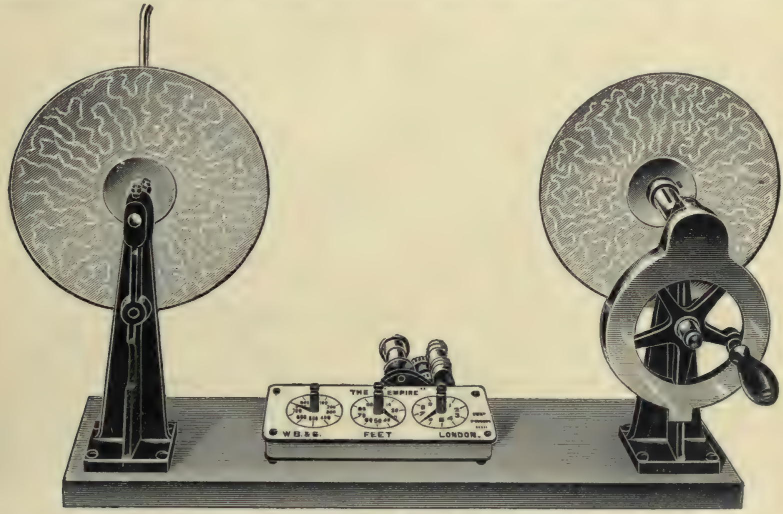


FIG. 29.—A POPULAR FILM MEASURER.

and lay the doubled up film under pressure between slabs of plate glass. Observation as to the alteration of register between opposing sprocket holes will soon show whether the film perforator is or is not at fault.

Where there is reason to suspect that rolls of film stock may be of short length—and perhaps also where there may be no definite reason for believing it—common sense would indicate the advisability of installing some check on film lengths, if such can be conveniently done at small outlay. Such an effective check is forthcoming in the little machine known as a film measurer, of which an example (that of Messrs. Butcher) is shown, Fig. 29. Unlike the perforator, the film measurer is a machine of comparatively low price. In the case of shortage of length of film consignments, it will save its cost in no time. It is also of service for checking the length of completed kinematograph positive films intended for projection. Moreover, the particular model here figured may, if desired, be on occasion pressed into general service as an excellent film winder or rewinder.

There is but one item more that need be touched upon in this chapter before bringing it to a close. It is not, strictly speaking, a piece of kinematograph machinery either, for it is just as applicable and almost as useful to the still view photographer. It is the pocket exposure meter, without which no conscientious picture man can ever consider himself fully equipped for his work.

Exposure meters are of various patterns, but most of them work on the same fundamental principal ; that of (A) testing the value of the light by means of a timed exposure of a strip of light sensitive paper, the test time being that in which the exposed sensitive strip occupies in turning the colour of a given painted patch upon the meter's face ; and (B) the ascertaining of the correct exposure by means of printed scales upon the meter, read in conjunction with the figure denoting the time taken by the test strip to darken, the aperture of the lens stop, and the rapidity of the film stock employed in the camera.

The two most used exposure meters are those known respectively as the Watkins, and the Wynne meter. Watkins meters run from 2s. 6d. upwards, Wynne meters from 6s. 6d. Both are, at a casual glance much like ordinary watches to look at, in fact, when had in sterling silver cases, they make very sensible and sightly additions to the blank end of a double swivel watch chain. They are figured below.

FIG. 30.—EXPOSURE METERS.

CHAPTER IV.

IN THE FIELD. SCENIC WORK.

Suppose ourselves ordered to take a series of exposures on some well known home beauty spot. We will try to set forth something of the system of going to work.

First we ascertain the length of film we shall require, and endeavour to obtain possession of stock as fresh as possible. It must be perforated.

Having got hold of the requisite perforated negative film and collected as many spare film boxes as required to hold it, load up and see that this is accomplished the right way. To load a film box, first open it empty in daylight and dust it well inside, after which examine the velvet lining of the light trap. Make sure this velvet is firmly stuck down and not lopping about lose inside the box, as the writer has known it to be before now. Also see to it that the lips of the trap are clean and free from grit. This may be done by carefully passing a slip of cambric between them on the point of a thin-bladed paper knife. Draw the cambric backward and forward till the slit is cleaned. Presuming the box is sound and light tight, it is now ready for loading in the dark room.

The arrangement of this dark room will not be gone into deeply here ; it is to be treated of in a separate chapter. Suffice it to say for the present that when loading film boxes, the room has to be illuminated only by a lamp capable of shedding a pure dull red light, and a by no means strong one at that.

Unfasten the top from the film tin, lift out the paper or foil enclosed roll of stock and remove all wrappings. Now run the fingers of the right hand round the celluloid rim of the roll gently till the end of it is found. The roll is now laid loosely over the bobbin of the film box, but *not* fastened to it by means of the spring clip used when threading a take-up box. The correct way of the loaded-in roll is such that the film unwinds from it parallel to the bottom of the box, as in fig. 8. Loaded in such a way, the tag of film sticking through the outlet (through which, of course, the end must be passed) will have its emulsion side uppermost. Should the celluloid side be uppermost,

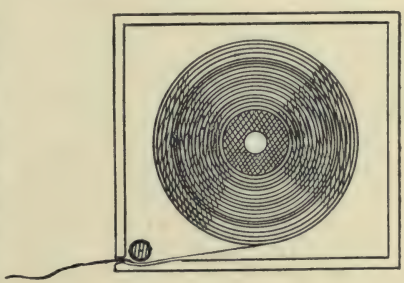


FIG. 31.

it is proof the film roll has been inserted wrong way round. When the film is loaded, and before taking the film box from the dark room, don't forget to put on the door and turn the catch securely.

As to the advice just given, to use a sufficient number of film boxes to contain all the stock for the trip, it will be understood this only applies to flying trips made in the home country, and where the amount of film used is not to be more than one or two thousand feet at most. Under such circumstances, it is a great saving of time and temper to do as suggested, and thus get rid of the annoyance attendant upon having to unload and re-load film in hotel bedrooms, etc.

Now to collect our kit before getting out and about. This should consist of the following: camera (with handle), view finder, film boxes, and take-up box, spring bobbins for clipping the film ends in the take-up (the same number of these will be required as there are charged film boxes), tripod with the necessary handle or handles for controlling the automatic gear. Probably, a stiff carrying case will also be included wherein to keep the camera when not in use, while another small piece of apparatus will find a place in the pocket of the really concientious and up-to-date camera man, though the writer is well aware it is in by no means general use by the members of the motion picture making fraternity. This last adjunct is an exposure meter, the nature and use of which has already been explained on page 24.

Let us now get to the actual filming operations. Artistically speaking, there are a good many more ways than one of going to work. One man will make it an invariable rule before touching the beauty spots of any locality to do a preliminary round of the picture post card shops by way of obtaining inspiration for his work. A hurried trip will then be taken to the scenes thus selected by him for the purpose of arranging with the local cottagers and others any simple effects of movement, such as milking, sheep-driving and the like, which may be possible.

The weak point here would seem to be chiefly the dependence placed upon the picture postcards in the first place. But yet, it must be admitted, the film man would often be at a grave disadvantage without them. Generally he comes to make his films on a strict time limit. He is not able to ramble about at his own sweet will day after day till he has discovered pet scenic effects for himself. What else can he do then but have recourse to previously existing photos of the locality? Let us grant all this. Yet even so, one can at least exercise the privilege of handling a conventional view from a slightly different standpoint to the usual one, and also, if possible, under rather different circumstances of lighting from the stereotyped conditions of the local view maker, and this much, in the writer's opinion, the first rate camera man should and will do.

Now to the technique of exposing a scenic film. Let us suppose we are standing before the subject to be recorded. It may be a water-

fall, a mountain path, or such like. The first thing to do is to take the height and direction of the sun. If the day is cloudy or dull, the same must be estimated as well as possible, though a really dull day can never be expected to yield results possessing any great amount of brilliancy and sparkle.

Having got the sun's direction, one notes whether this will be to the front, back or side of the camera when the lens is pointing towards the required view. Roughly speaking, the best position is when the sun is behind but not quite at the back of the camera. Such a standpoint is at least more often useful than any other. With the sun right behind you get a flat result. With the sun quite to the side, shadows thrown by the various objects in the view are apt to become obtrusive, though this is not to say such an effect is always an evil. Sometimes even for special effects, one may photograph with the sun straight in front of the camera, provided it is high in the heavens, and the lens glass is kept well shaded from its rays. That remark has no connection with the making of so-called moonlight effects, where the lens is pointed right at a cloud behind which a low sun is shooting out its rays. Such 'moonlight' work almost comes under the head of trick photography, whereas the effects obtained with a high sun and well-shaded lens are often highly pleasing and artistic. They are, however, more of the nature of advanced studies for the hardened camera man, and not the sort of thing to learn upon. Let us lay down for a start then that we may have the sun anywhere within a semi-circle of which the middle would point toward the back of the camera, and provided also the objects we want to stand out in the film record are well illuminated. This is giving the lie direct to the suuperstition that flat back lighting is the right thing to make for, such an idea being absolute bosh.

Having selected view and lighting, which is best done with the aid of a box view finder, the next thing is to carry the camera kit to the point from whence the desired effect is obtained, and fit up. After that, focussing is accomplished either on the threaded film itself, should the general light be good, or on a piece of matt celluloid placed in the gate for the purpose, where lighting conditions are poorer, or the motion picture man's eyes not quite up to the strain of framing a sharp image on the somewhat opaque sensitive film. (Instructions for threading film were given in Chapter 3.) For the purpose of focussing, and supposing a reasonably good lens is being employed, the full aperture is utilised, while the object sharply focussed is invariably to be that which is of most importance in the finished film.

Now re-thread the film in the gate (supposing it has been taken out for focussing on matt celluloid) give a last look at the film and escapement to see all is in place, attach the camera handle and give a half-turn with the left hand door open, watching the while to make sure the escapement and take-up are going right. See that the door of the take-up box is in place, then close camera door securely, and *proceed to take the light value with the aid of the exposure meter.* This

is the very best advice the writer can give, and those who follow it from the first will not regret doing so. There never was a greater absurdity than the idea current among some camera men that one is not a finished photographer until one can tell the light value 'by instinct.' No one can tell the light value by instinct. The most they can do is to stumble upon the correct exposure for certain average classes of conditions, which conditions will be for ever deceiving them, and causing them to make howling mistakes right up to the end. *But they won't admit it, and so to themselves they seem to have achieved the impossible.*

'Don't run before you can crawl' is a good motto, but in the present connection, its application is indirect, since no sensible man ever pretends to have got to the stage of perfection as regards judgment of exposure, and those who do pretend to it are not sensible men.

Now to set the stop and shutter aperture. Here is real scope for a master hand.

In the first place, supposing the light is very good, we shall probably find ourselves placed with the alternative of very small stop or equally small shutter aperture. If we adopt the former course and stop down tremendously it will have the effect of putting the whole of the view into marvellously sharp focus. But don't run away with the idea that this is always the best thing to aim for. For instance, the scene may embrace a waterfall, which can't be too sharp, and which has therefore been focussed upon in the first place so that it will be sharp anyway, and there may also be a range of mountain peaks and hills in the background. But these latter, especially if tree-clad, might quite possibly be made much too sharp by over-stopping down, in which event the trees upon the hillside would compete with the waterfall for supremacy in the view, so spoiling the effect of each part of the picture. Here is a simple matter for the camera man's skill and good judgment. The stopping should be carried to a point where a reasonably harmonious result shows itself on the focussed picture, and the rest of exposure adjustment must now be made by narrowing the shutter aperture.

A word about lens stops or diaphragms. In the form of lens attached to kinematograph cameras, alteration of diaphragm is effected by the movement of a ring or pin on the lens mount which causes the 'iris' inside to open and close like the iris of a cat's eye, except that the hole in the middle always remains circular in shape. Around the lens barrel will be found engraved numbers which on English lenses run somewhere as follows: f4., 5.6., 8., 11., 16., 22., 32. Sometimes the numbers are slightly different to these, such as f3.8., or f11.3., for instance. Such minor differences need not be very seriously taken into account.

What about the virtue of engraving lenses with these 'F numbers'? The answer is that every lens, no matter how great its size, or 'focal length,' works (theoretically at least) at an identical speed

when set at any given aperture. Thus, if the photographer has in his camera set a two and a half inch and a three and a half inch lens, both of them will require the same exposure when both are set at f8, for instance, or f11, or any other similar ' F number.' But these aperture numbers possess another use beyond the above. Each aperture requires double the exposure of the last, thus: if with a lens at f4, the camera man finds the correct exposure would be the eightieth of a second, then the exposure would be the fortieth of a second (approximately the actual kinematograph exposure) at f5.6, or the twentieth of a second (which would be too slow for practical work) at f8. In the latter case the shutter aperture would, if possible, have to be considerably widened in order to avoid under exposure of the kinematograph film. And this brings us to the shutter itself.

Sixteen pictures are taken per second, during which time the shutter is making one revolution at uniform speed for each picture. It follows as a matter of course that with the blades full open (in which case the metallic sector will usually be approximately a semicircle, the rate of change in kinematograph cameras being about one to one), each effective exposure will be somewhere about the duration of a thirty-second part of a second. To simplify matters, let us say the actual exposure under such conditions is the fortieth part of a second, then by narrowing the cut-away portion of the shutter to a quarter circle, exposure time is reduced to one eightieth second, while with only one eighth circle shutter aperture, there will be only the one hundred and sixtieth part of a second allowed for each succeeding exposure.

Nothing but excessive light can justify the narrowing of shutter aperture to such small limits as the last. As to helping the photographer in photographing rapid motion, it does nothing of the kind. In kinematograph work one is not concerned with the freedom from movement blur or otherwise of each single picture. It is true, of course, that given sufficient light and a sufficiently rapid lens coupled with an extremely small shutter aperture wonderfully sharp pictures (sharp, that is to say, in the sense of being free from blur caused by recorded motion) might be obtained of such things as galloping horses, racing motors, etc. *on the film.* They would not project as well even as would a film in which the individual pictures were distinctly blurred through using a comparatively wide shutter aperture. For, whereas in the latter case the eye might see on the screen a somewhat confused impression of the speeding objects, in the former the only result of abnormal closure of the shutter blades would be to produce on the projection screen a double, triple, or multi-outlined image. Hence one has to realise from the start that the shutter of the motion picture camera, like the lens, takes a lot of knowing, for whereas the principal object in a given film should always be sharp as far as its focussing goes, that is not to say the shutter is also to be adjusted so as to eliminate all movement blur from the record.

As a working basis for the novice at the camera, it might be laid down that generally speaking, and provided the light allows, a stop of about f8 with a shutter opening of one third of a circle is right for most things. If the light varies one way or the other, it is best to make the lens diaphragm anything from f5.6 to f16, according as the exposure meter directs, rather than manipulate the shutter opening. This applies to all scenes where there is a fair amount of movement. Only when the movement to be recorded is very slow, as for instance in panoramic views where practically the whole of the motion is transmitted to the picture by rotation of the tripod head, is it safe to narrow down the shutter greatly rather than lose the effect of atmosphere and softness which would result from over-stopping down to compensate for undue light, or for a flat and over sunny foreground.

The above, at any rate, embodies the writer's general system. Needless to say, there are other, and in some cases, contrary views held by various workers.

But while on this subject, there is another point about lenses which must not go without comment. It is the question of their focal length.

Upon the focal length of a lens—in other words, upon the amount of distance between the optical centre of a given lens and the focussed image of a distant object produced by it upon the kinematograph film—depends a most important qualityof the picture: the relative importance of foreground and distance. Figs. 32 and 33 are intended to make the reason of this clearer. In each case, AB represents the focussed kinematograph picture, which is, of course, always of the same external dimensions upon the film. CC in the two figs. are two lenses, one of which (C, fig. 32) has a focus three times that of the other. That is to

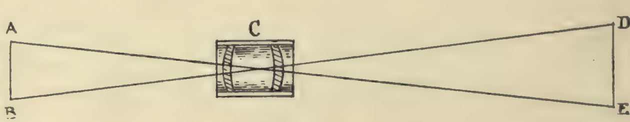


FIG. 32.

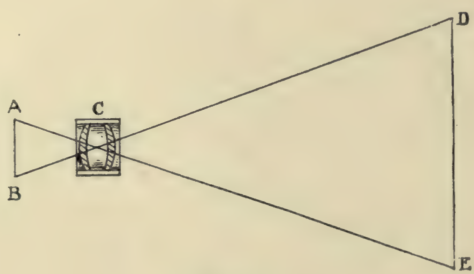


FIG. 33.

say, its optical centre when it is focussed upon some distant object is three times as far from the film AB, as is the optical centre of the lens in fig. 33. The lines CD, CE show in each case the comparative amounts of view which will be included on the film picture by the two lenses. It will be seen at once that the direct result of the added focal length of the lens in fig. 32 is to cut down its 'angle of view,' so that proportionately less of the foreground is included in the picture thrown by it, while far away objects must, of necessity, be greatly magnified in size so as to fill up the space vacated by their nearer neighbours. The result is therefore as already set forth :—the longer the lens's focal length the more the distance stands out in the picture, and the less of the foreground is included. To return to the practical aspect of the matter. The average 'focus' (the ordinary loose way of referring to focal length) of a taking lens for kinematography, is in the neighbourhood of three inches. It is not usual to go below two and a half inches on the short side, and indeed only a few of the cameras on the market would be able to be fitted with a shorter focus lens than this. On the other hand, long focus lenses may run easily up to four or five inches, while for natural history work, photographing wild animals, birds on their eggs, and some other specialised kinds of kinematography, much longer focus lenses even than the above have been employed with success. It is said that the well-known kinematographer of wild life, Mr. Cherry Kearton, often makes use of lenses of nine inches focus or thereabouts. The longest focal length which will be found of general use by the moving picture man is somewhere in the neighbourhood of four inches, while if, as is quite possible he has to do all his work with one lens, three inches is the 'all round' focus to make for. This point of the kinematograph lens's focus is raised here by way of exemplifying yet another factor in which the scenic photographer may be called to display his skill.

Now we will assume the moment for exposure has arrived. The camera is focussed, the take-up box looked to and closed tight, the camera also closed securely and pointed to the scene to be taken, and we will suppose the finder is in its proper place on the left-hand side of the camera, and as nearly as possible on a level with the lens. There is nothing now to wait for but a satisfactory state of the picture before we let fly upon it.

It may be a waterfall we are taking—the same one we were focussing a while ago—in that case, it is always at work and ready for us. Give a glance upward to make sure there are no clouds drifting toward the sun, or if there are, that they will only serve to enhance the general pleasing effect of the picture by the play of light and shade that comes sweeping over the landscape in their train, then all being well, we may turn straight away. Twice a second the handle has to go round with most modern cameras. Each turn accounts for eight kinematograph pictures, and we must see to it the rate of turning is uniform, and that there are no 'dead points' during the twirling of the handle (otherwise, moments when the hand slackens off, and allows

a partial drop in speed during the revolution). While we turn we keep an eye upon the view finder to see that the scenery is all right, and incidentally that the camera is not vibrating unduly. If it is, or if the tripod legs or head are not screwed up tight, or if the tripod is not widely enough spread, or if it is planted upon a bed of springy heather, one will soon know it by jerking of the image on the finder glass as soon as work commences. Stop turning and put matters right before resuming. Never mind wasting two or three feet of film if by so doing it is possible to convert the rest of the subject from indifferent into good work. In every case of negative making, unless the length of the subject taken happens to be such as to use up the whole of the roll of stock, its finish is marked on the threaded roll, either by means of the film punch or by opening the camera door and snipping a bit out of the film perforations with a pair of pocket scissors. See fig. 34.

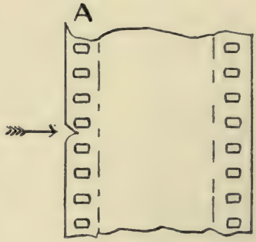


FIG. 34.

Where the view to be taken is a panoramic one, known familiarly as a 'panoram,' there will also be the handle of the tripod head to be turned with the left hand while the camera handle is twirled with the right. This is not so easy as it sounds, even when the required direction of camera swing makes it possible for both hands to go the same way. For one thing, the rate at which a panoram is swung depends generally on a much slower motion of the hand controlling the turntable handle than the regulation twice a second which must *always* be given to the camera handle. With the turntables used by the writer, one revolution of the turntable handle to every two of the camera handle has usually been as fast as it is wise to go for good quality in the results. Slower rates for the turntable are a matter of the photographer's own judgment, but when it is necessary to swivel the camera round quickly many degrees in the course of taking a picture, even where the tripod mechanism provides for this, such abrupt rotation should never, under any circumstances, be allowed to show in the completed motion picture.

Stop the camera while re-adjusting in such cases, or, if you don't do that, then later on, when making up the negative for printing, just cut out the part where the quick turn comes. The gap brought about by such procedure will never irritate the audience half as much as would the horrible brain-racking blur occasioned by including the over quickly rotated portion of film with the rest.

But, as has been hinted, the turntable has not invariably to be rotated the way it will go when both hands turn their respective handles in the same direction. It has also on occasion to go the other way. This means either that the camera man has to master the art of twirling two handles with his two hands in opposite direc-

tions at the same time and at differing though respectively uniform rates—either that, or he must do what many a kinematograph photographer actually does do, and take an assistant with him to manage the turntable according to pre-arranged word of command. The latter is, of course, the easier way, but never forget a man is not real master of his instrument until he can do passable work quite on his own, and manipulate turntable and elevating device as required while still attending to the revolution of the camera handle.

The last sort of scenic subject to be touched upon in this lengthy chapter is even more difficult than the foregoing ones, for while it demands all the knowledge required up to now, it requires in addition something more—the ability to manage live things—men, women, children, and animals. Moreover, to the class of pastoral film calling for such exceptional knowledge, most of the really successful outdoor scenic (to say nothing of topical) work belongs.

It is no light task to mind your camera, see to your turntable and elevation, keep a smiling face for the pretty country girl in the pastoral film, and give the necessary directions to the farmer's boy for the stage management of the ducks and calves, all at the same time. If it looks light work, that only shows that the 'man behind the gun' knows his business and knows it well. He has learned that if he seems to be working, the joy of what is being regarded by his amateur helpers as a 'piece of fun' will go from their faces. The smiling girl will smile no more, but only look alarmed or else self-conscious, as so many other country maids have appeared before now in otherwise excellent motion picture films. So our kinematographer smiles the while he surreptitiously flicks away a trickling drop of perspiration from his cheek, and the handle on the right of the camera does its twice a second, and the two other handles on the left of the turntable do their allotted tasks, while the farmer's boy hollows and the live stock wallows, and the farm maiden sorrows, or laughs, as the case may be. And all the while, the film recorder tick-ticks its tale of 'something attempted, something done' in terms of feet of exposed stock.

It is over. The gate goes easy, betokening the end of the film supply, and hence the enforced finish of the subject. At last the motion picture photographer may relax his efforts. He notes particulars of subject and exposure either in his note book against the number denoting the take-up box or else on the ivorine writing tablet upon the box itself, then produces a handkerchief and mops his brow, while the young lady assures him it was 'awful fun being taken,' and the radiant farm lad waits expectant.

"The expected" has been presented. And now the camera is packed and we are on the homeward march. It doesn't look much. 'so simple,' as the conjurers say, and even the photographer, now it is over and he has taken a final look at his film gate so as to make sure it is still bright (since otherwise, it is next to certain the film

would after all have been scratched, and ruined)—even the jaded photographer begins to feel it wasn't so difficult after all, only a bit of nerve strain for the moment. But it is just that expenditure of nerve force which alone can bring success to the picture man.

AN AWKWARD SCENIC SUBJECT.

CHAPTER V.

TOPICALS.

How to get to grips with a topical—that sounds easy. Generally speaking, when it comes to the point it is anything but so. For instance, let us grant we have arranged the catching of trains and other necessary conveyances so as to bring us up with the earliest of the crowd round about the event to be filmed. We then begin to find for a start that any attempt on the part of the camera man to barge his heavy apparatus through a crowded throng of onlookers is not liable to be popular, nor will it probably be successful.

There are three possible ways out of the difficulty.

(1) Use your own powers of persuasion to cajole the people in your way into moving out of it, or if you have enough and strong enough assistants, set them to 'police' a way for you.

(2) Select a pitch as high up as possible (say, on a high pavement or in a house porch) elevate the tripod legs to their fullest extent so that the lens looks over the heads of the bystanders, and proceed to operate, standing on the top of the stiff camera case, which is made specially strong for the purpose.

(3) Select an eminence right above the crowd, get to it somehow, and operate from there with the camera pointing partially downward.

Where the importance of the occasion warrants it, method 3 is for obvious reasons the soundest way of going to work. Incidentally, it is the one generally in vogue at the present time for obtaining records of state processions and such like.

For all that, and admitting its many advantages, there are still possibilities for things going wrong. For one thing, even supposing a place has been duly rented, it sometimes happens that the camera man will not find himself alone in his position, and the company of a second and unknown motion picture photographer under such conditions, may lead to trouble which was little dreamed of. As a case in point, there comes to the writer's memory the story of how a certain raised platform at Paddington Station was let out to two picture men on the occasion of the funeral of the late King Edward. Each operator was to occupy half the platform, but at the last moment there arose a doubt as to which of the two had the right to the better half. It is not recorded whether on this occasion the rival men came to blows. Certain it is, however, there was some hustling and a hasty appeal to the railway authorities before the matter was finally settled. And all that time, valuable moments of preparation for the filming

operations were being wasted. That is a case where carelessness on someone's part was responsible. There are also occasions when difficulties arise through other causes.

At a certain race meeting not so long since, a hopeful camera man found his view blocked at the last moment by the attentions of his rival's assistants, who kindly let off smoke rockets in the field of his lens while the horses were running. That is a sort of thing there is no guarding against, and the only moral here is to keep a weather eye open for such things as may crop up, and take all possible measures which human nature may forsee to circumvent disappointment.

Lastly, as an unexpected set-back especially likely to affect the renter of a seemingly ideal position for filming a public ceremony, may be mentioned a common circumstance for which no one really is to be blamed. It follows simply and solely from the natural cussedness of things, yet it is none the less damning to one's results. It is the unlooked-for nuisance of decorations at the last moment.

The representative of a speculative film house sees a window to let from which a perfect view is obtainable of the street down which some pageant or procession is to come. He takes it, pays good money for it, and congratulates himself he has done more than well for his firm. The great day arrives. Camera man or men are despatched to their pitch. What do they find?

They find a gaudy flag pole newly painted in such a position as to cut their view right down the middle, but this is not all. Across the important part of the picture runs a line of silly baby flags. They are too near to be focussed and made use of in the general scheme of decoration as depicted in the kinematograph picture, and they bob up and down in the breeze, not so obtrusively at first, perhaps, but do not be deceived. They will not fail when the procession hoves in sight. And they do not fail. Just at the critical moment when one holds one's breath in the expectation of securing the film's vital point, a long, snaky bunting streamer switches down, down, plop! and the whole view is temporarily obscured; not for long, only just long enough to spoil the film.

The foregoing is an old tale to the hardened topical man. The neophyte will perhaps be better able to steel himself against the future after reading it.

Sometimes, as in the case of state processions, the preliminary wait is liable to be on the long rather than on the short side. Even so, the very length of the interval brings in its train unexpected pitfalls. For instance, the light value may be taken, and the lens stop and shutter set accordingly in the same way as for scenic work, except that when possible (which is not often) the exposures on topicals should err rather on the long than the short side. But suppose after all this, there is a wait of an hour or more before the actual filming can be commenced. In towns, especially, light values alter enormously at very short intervals with the result that one may as likely as not be led into bad under-exposure notwithstanding all precautions taken.

Let us turn to the other side of the picture where everything has to be done in a tearing hurry. This is far the most frequent state of things. Here the only chance of coming out well from the ordeal of filming a difficult topical is to have every adjustment that can possibly be made beforehand ready cut and dried by the time one's stand is taken for work. In most cases this will mean that the shutter has been set right, the film threaded, and the take-up adjusted all ready before starting out on the filming expedition, but this is not all. To be smart in topical work there is another adjustment which should on no account be left unmade. Even for scenic studies it is handy enough, though perhaps somewhat liable to lead to slovenliness except in the most expert and conscientious hands, but each and every topical man should have it on his camera. This adjustment is the setting of the lens scale.

Scaling a motion picture lens is really a very simple matter. All it needs is ordinary care to make it accurate, but care must be expended upon the operation, or it will be worse than leaving it undone altogether. It is performed in the following way.

First set the focussing screw or flange-pointer of the lens rack back to its farthest extent ; that is to say, focus the lens back in its jacket as though focussing a distant object, and then continue the motion until the jacket will go no further back. Now pull out the lens bodily from the rack mount. This is, of course, presuming that the instrument is of fairly modern design, where the barrel carrying the lens is separate from the rack mount, and slips in and out of it as do the lenses in kinematograph projectors. Gradually insert the lens barrel more and more back into its mount again, at the same time watching through the focussing tube of the camera to see when some distant object, a far-off tree or chimney-pot, say, becomes sharp. Make certain the distant object is as clear as possible, then scratch a ring on the lens barrel at the exact point where it commences to be covered by its mount. Fig. 35A illustrates the act of scratching the lens tube thus with a sharp-pointed instrument, such as the blade of a knife, while in Fig. 35B, the lens barrel is supposed to have been again withdrawn, showing upon it the scratch so made.

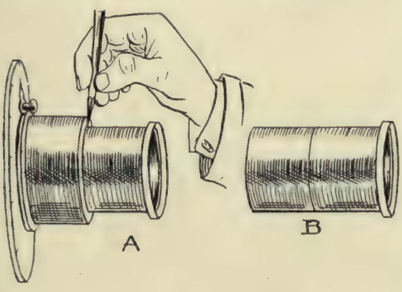


FIG. 35.

A moment's thought will now convince us that in future, each time the lens setting is put back to its furthest point, and then the barrel pushed in exactly to the point where the scratched line becomes level with the edge of the mount, we shall have a position in which very distant objects, technically spoken of as 'infinity,' will always be sharply focussed. All that now remains to be done is, starting

with the above adjustment, rack the lens setting forward till objects at varying known distances (which must be first carefully measured off) are respectively in focus. As each position of the rack mount corresponding with focus for the various distances is determined, we engrave on it the position of adjustment so that it can be again arrived at with certainty. Fig. 36 shows a setting of the focussing flange type with the various 'scale distances' engraved upon the metal plate beneath the movable focussing handle. Where a new camera is being ordered this scaling might be undertaken by the lens makers. Usually it will fall to the lot of the photographer.

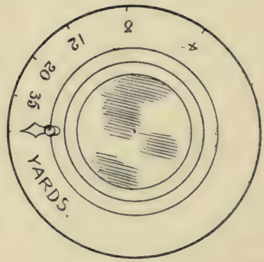


FIG. 36.

For practical purposes, and provided the light is good enough to allow of the use of a stop not larger than f5.6, it is safe for the motion picture man to set his lens at thirty-five yards in lieu of focussing on a topical film, as this will be certain to put any ordinary subject in focus, no matter whether the figures are being taken small or fairly large. Where it becomes a question of working so as to obtain results at very close quarters, say figures three-quarter length, or larger, or where a very large stop has to be used on account of bad weather, the lens scale must be set for nearer objects accordingly, and in this matter the photographer's own judgment is the only criterion. It may be said that the accurate use of the focussing scale, while it may sound simple, is really quite an art in its way. The general rule given as to the medium stop and thirty-five yards setting for all ordinary subjects will, however, be found a real boon to the hurried and worried picture man.

By its means it is possible on numerous occasions to erect the camera, ready threaded and scale focussed, bring the view on to the field of the lens by means of the tripod adjustments and use of the box finder, and begin turning right away, thus often catching a fleeting effect, which would otherwise be entirely missed. The only matter which is here liable to be more or less neglected is the light. But lighting in topical productions is seldom of the best, either as regards direction or exposure. Still, on this matter also, the tied-for-time operator might carry well in his mind the rudiments of the lessons on stop and shutter in their relation to exposure as given in the previous chapter. As to coping with those extra bad lighting conditions which seem to reserve themselves almost exclusively for such occasions as the present, when the film cannot be duplicated, the one and only great way of being ready for the worst is to have the camera fitted with the most rapid lens available. And here, too, the moving picture man has advantages far ahead of his still picture rival.

Considerations of depth of focus (see Appendix) bring it about that the longer the focal length of any lens, the less wide is the largest aperture at which it will give the required definition in all planes of a given view. Consequently, it follows that in this matter of wide aperture—which means rapidity in working—the moving picture man has things comparatively all his own way. For instance, while a lens working at f3.5 and having a focus of six inches would be useless for most things to the still picture photographer on account of the impossibility of focussing different planes sufficiently well together, a lens of similar aperture—that is to say, speed—and of just half the focus is quite feasable in moving picture work, and is indeed very largely employed. But even this does not sound the limit of lens rapidity for the kinematograph camera operator. One of the early moving picture lenses put out by the firm of Dallmeyer had a working aperture of f2, though its covering capacity might, perhaps, have been improved upon, while the same firm now supply an instrument working as fast as f1.9. Further particulars of this marvellous lens will be found on page 19. Suffice it to say here that the actual rapidity of such a lens would be more than four times that of one working at f4.

Even when a topical has been successfully secured, it must not be imagined that the battle is over. Having exposed the film, the next thing—and often a very difficult thing, too—is to get back to the dark room and place the exposed stock in the hands of the developing staff with the utmost possible speed. This means that in topical work one must be as careful in making arrangements for the return journey as for the outward one.

Occasionally, for instance, after a race meeting, it has been known that taximeter cab drivers have disconnected their taximeters and flatly refuse to return their fares to their base except at a ruinously large figure. In such cases it may even be best to pay up and never wait to haggle ; all depends upon circumstances, as the cab driver knows only too well. Then, again, return trains may be terribly late in taking back crowds from the regions where topicals are made, and the chances of the motion picture man coming in for more or less bad luck during his experience of such work amount almost to a certainty. Once again, all the advice that can be given is to set out with your eyes open, with a just estimate of what may be the money's worth of an extra hour or half hour gained in getting back to the developing room, and as a last resource to carry on you an extra coin or two for unforeseen emergencies. 'Money makes the mare go' is an ancient proverb which none the less keeps wonderfully fresh with the years.

And now for a last piece of advice applicable enough in all forms of outdoor work, but particularly so in the case of the maker of topicals—don't forget to look after the body as well as to attend to the picture machine. A chilled man can't focus correctly or turn a handle evenly, leave alone keep all his wits about him for the chances

of the day. Neither can a hungry—or worse still, a thirsty—man do justice to his work. Never start out on a cold day without a warm coat and warm gloves. Don't set off upon a long day without food and drink (enough, but not too much of the latter) ready to hand. And if you get wet, change as soon as possible. That last sounds homely, not to say grandmotherly, advice, but a long and varied life teaches that in some respects our grandmothers knew just as much as we do ourselves, and certainly you will come round to that opinion if you find yourself laid up in bed through neglecting the above timely word of warning.

THE KINEMATOGRAPHER ON THE BATTLE FIELD.

ILLUSTRATION 37.

CHAPTER VI.

THE DARK ROOM.

When a length of negative stock has been exposed, the next operation is the development of it. This takes place in a 'dark room,' which is a special workroom fitted with suitable work benches or 'winding tables,' also with the necessary chemical and washing troughs and having as its sole illumination during development time a suitable number (one or more, according to circumstances) of lamps emitting a feeble pure red light.

First as to this light arrangement. Where work is being conducted on a fairly large scale, nothing can be better than to have suspended from the ceiling, rather high up and over the winding tables and troughs, a number of eight or sixteen candle power electric incandescent lamps, each of them encased in a special ruby glass cover obtainable from the usual trade sources. Before installing the scheme of illumination, it will be necessary to go over the workroom set apart for development and make quite sure that every vestige of extraneous light, as for instance daylight, has been prevented from coming into it during film development. Means must also be provided for workers to enter and leave during work hours without light coming in through the open door. This will necessitate the provision of a dark room exit fitted with double doors, having a dark chamber between them to form a light trap. If these doors are set on springs, and the chamber of the light trap be sufficiently long to make sure of the first door closing before the second can be got to and opened, it will be possible for a worker to walk in and out of the dark room without the least fear of daylight being let in upon any film in course of manipulation.

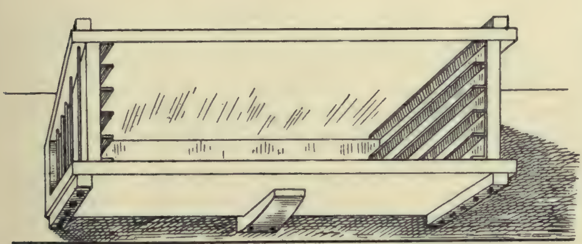


FIG. 38.—A TROUGH WITH DIVISIONS.

The troughs necessary for the development of a length of kinematograph film are three in number. They consist of the developing trough proper, a washing trough fitted with syphon arrangement for keeping the water in it constantly changed, and a fixing trough. The usual dimensions of each of these are about thirty inches square by three or four inches deep, varying according to the size of frame used (see later). They are made of glazed earthenware,

and are fitted up in a row on brickwork supports at about the height of an ordinary table. The washing trough is the central one, while all three should have water taps over them for purposes of filling, and should also be provided with efficient waste pipes for emptying. In the case of the washing tank, this waste pipe is in addition to the syphon arrangement already referred to and which latter is used when it is desired to keep the water changed without lowering its level in the trough.

Further, it is absolutely necessary that the developing trough should be provided with means for raising the temperature of its contents in winter time, while the fixing tank may also with advantage be fitted with a similar arrangement. A small gas ring under either of the two, placed at such a distance from the earthenware as shall introduce no risk of cracking it through too abrupt heating, will answer the purpose, the flame being suitably subdued by placing over the ring such an obvious safeguard as one of the well-known asbestos mats sold for use on stoves and ranges. We also want covers for both the developing and fixing bath. These may be made of wood, and fitted with handles for easy raising. The developer cover, in particular, should fit well and closely, as on this point being observed depends much of the life of the comparatively expensive developing solution.

The above, with the addition of a winding table, gives a fair sketch of the average developing unit of a small commercial concern. Each such unit can tackle one length of negative or positive film at a time, so that the number of them to be installed becomes a matter of simple arithmetic to be decided by the number of hands engaged upon the work of development. Large works will not be in want of any hints on development contained in this book, while for the benefit of the small man (for instance, the picture hall manager who aspires to have his own camera and turn out an occasional local film) there will be further remarks on developing ways and means later on in the chapter.

For the present let us pass on to a fuller description of the winding table, which has already been lightly referred to more than once. We will first proceed to describe the use of this winding table in connection with a well known system of film development known as the pin-frame system.

In order to develop a roll of exposed film on a 'pin frame,' it is taken out of the take-up box and attached by means of a loop folded in its end to one of the four innermost pins, as figured in illustration (39). A careful look at this illustration, or better still, at the real article, will reveal the fact that the pins are so put into the frame as to admit of a length of film being wound around them spiral fashion, after the manner indicated in fig. 40. This, in fact, is the actual system made use of by the developing hand. The exact manner of going to work to accomplish the winding of the film spiral fashion on the frame will be described presently, but the net result is that

once the task is accomplished, the exposed stock is in a state in which it can be handled with comparative ease, for the otherwise limp celluloid is kept practically rigid, so that it is only necessary to immerse the wound frame in any liquid in order that the whole surface of the emulsion may be simultaneously and equally wetted.

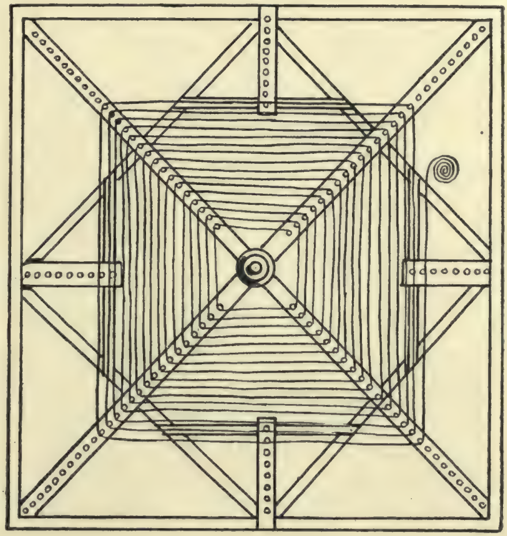


FIG. 39.—PIN FRAMES FOR DEVELOPING.

In order to wind successfully, the dark room hand must be provided with a suitable amount of clear 'table top' surface upon which the frames may be laid and, if necessary, rotated during the process. These wide clear bench spaces are the winding tables alluded to, and they must be of sufficient size and placed at the right height above the floor to accommodate the pin frames employed, and also to provide the worker with as much help as possible in what is admittedly a difficult and tedious operation.

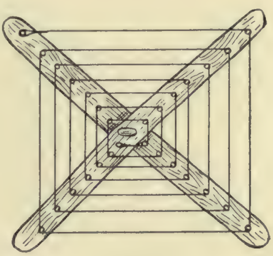


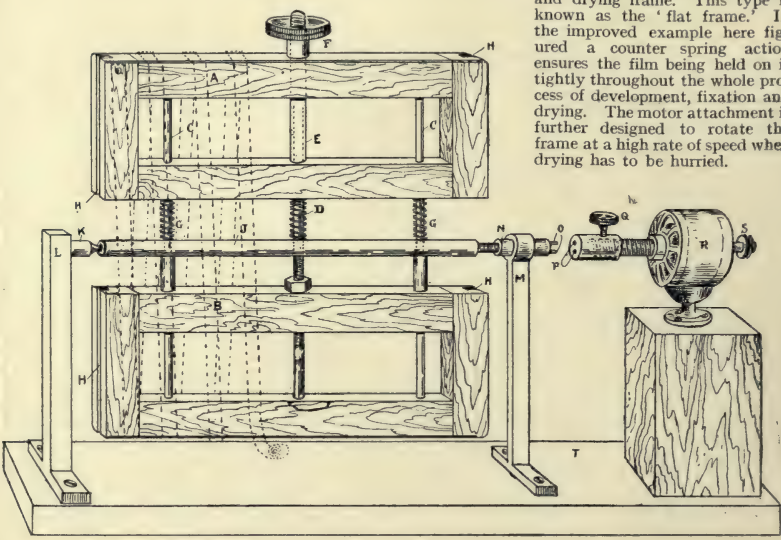
FIG. 40.

The 'pin frames' themselves are usually made of brass, though very soon after use the metal will be found to have become plated over with silver from the developing and fixing baths. A sufficient stock of frames must be laid in to meet all emergencies. Also, provision for storing them when out of use has to be made, and in seeing to this, it is well to remember the pins on them are very delicate and easily bent, while a single bent pin discovered too late, or perhaps not discovered at all, may throw the winding hand out, and lead to nasty complications and a messing of the film. Either the wall or ceiling of the dark room are the best places to hang spare frames ; the ceiling only if it is a very high one. Full sized pin frames average somewhat over two feet square and accommodate up to 200 feet of film.

An alternative system is by means of the flat frame, an improved form of which we figure and describe hereunder. Its advantage is in the matter of easy winding, and its disadvantage is its large size for a given capacity of film, as compared with the pin frame.

FIG. 41.

A novel combined developing and drying frame. This type is known as the 'flat frame.' In the improved example here figured a counter spring action ensures the film being held on it tightly throughout the whole process of development, fixation and drying. The motor attachment is further designed to rotate the frame at a high rate of speed when drying has to be hurried.



Action of the frame.—The lowermost portion (as figured) is made firm with the central rod J. The upper portion H slides up and down freely on the guide rods C, B, E, but the wound film (shown in dotted lines) is kept on tension by means of the counter springs G, G, D. The pin attachment connecting the frame with motor screws off during development, which is conducted in a grooved trough. For drying purposes the motor rotates the frame on its axis K, N.

A short while since, we gave a description of the minimum number of troughs comprising a developing unit. While the three described would be enough for the purpose set forth, it unfortunately happens that more or less often, according to circumstances, the course of development does not run smoothly, in which case after-treatment of the film will have to be resorted to. Consequently, there should be at least two other troughs set by themselves, and allocated to such after-treatment methods. Probably the two will do for three or four developing hands to share between them. In fact they should do, or it means that carelessness in the workroom is becoming the order of the day—unless the business is largely in topicals, in which case anything is to be expected. The place for after-treatment baths is, however, not the dark room, but another workroom arranged so that it may be partially darkened or well lit at will.

Before closing the description of the developing room, it will be necessary to say that the winding tables must be placed well away from all chemical and other baths so as to avoid fear of splashing the

dry film. The opposite side of the room is where they should be. Also, at least one clock must be provided, and in order that it shall be of use in the semi-darkness, it is necessary to have a red light burning before its face, or preferably have the face transparent with a red light burning behind it, and numerals painted so as to show out dark against light, after the manner of an ordinary illuminated street clock. This, and the provision of space for film boxes, completes the dark room fittings as far, at any rate, as necessity is concerned. It is not advised that any portion of this apartment should be set apart for storage and weighing of chemicals. All that side of the developing business should be kept to a special 'chemical room,' which should be a small one lit by ordinary day or artificial light.

We have treated the developing fittings, so far, from the ordinary commercial point of view. Let us now say a few words upon the experimental or 'one man' kinematograph dark room, since this aspect of the developing problem is sure to be of service to some, at any rate, of the readers of the present volume.

Perhaps it is safe to suppose for a start that in the case of the small one man show, expense and weight of fittings are both items to be considered. Probably the dark room may not be on the ground floor, in which case the installation in it of brickwork supported earthen troughs would be a difficult and even dangerous proceeding. For such, the necessary baths may be fashioned out of zinc, excepting the fixing bath, for which sheet lead is the material to use. Naturally, such troughs will not last one-tenth of the time the other and heavier sort would. Still they will suffice, and that is the great point. Then take the matter of size. This is important in experimental work.

Where pin frame development is employed there is no need for full-sized frames, constructed for winding on whole 165 feet or 200 feet rolls, as the case may be; 100 feet frames are much smaller (under twenty inches square). Moreover, they can be obtained made so as to take to pieces like the blades of scissors for the convenience of picture men touring their own developing kit in foreign countries. When using such half-size frames upon a full length of film, it is of course necessary to cut the exposed stock in two. This, however, need cause no noticeable break in the continuity of the picture, provided both halves of the length are similarly developed and afterwards carefully joined together previous to printing. Full details of how to accomplish this joining up will be found elsewhere.

The provision of at least one suitable photographic red light, as also of a winding table and dark room clock which may be seen during development is still a necessity. Previous remarks also hold on the matter of making provision near the winding table for stacking both full and empty take-up boxes, as well as a small supply of tins of film stock sufficient for present needs. The dark room is not the place to store unexposed film stock in bulk.

The foregoing is a fair description of paraphernalia for film development on a small to medium scale, but before closing the chapter, we

feel a warning must be added to the above. Some firms dealing in kinematograph supplies include in their catalogues 'developing drums suitable for the amateur and small worker.' Accompanying this announcement there is generally a cut showing a revolving roller half submerged in a semi-circular trough after the style of the tiny arrangement of the sort actually employed by users of toy hand cameras for the development of their snapshots. However satisfactory such an elementary description of developing drum may be in the hands of the snapshotter, its applicability to kinematograph film only figures as a matter of history. No one in the know uses such an arrangement now for the very best of reasons—it is an inferior system to all others, and one wherein certainty of working is reduced to a minimum. When we see crude kinematograph film developing drums included in the apparatus catalogues of reputable firms, we can only hope they remain listed through mere oversight, and not through any mean attempt to spoof those not in the know out of the ranks of an admittedly comparatively closed profession.

A drum is used in kinematography and a very large one, too, but it is not employed for development. It is a huge unwieldy affair (generally speaking) fashioned in skeleton out of laths of wood, and its purpose is to accommodate film during drying. But this item of the film producer's apparatus will be dealt with further when its turn comes.

42.—Drying Room in the British and Colonial Co.'s Establishment

CHAPTER VII.

DEVELOPMENT.

Let us start by taking a bird's-eye view of the process upon which we are about to embark.

The first thing to do before developing is to get the baths compounded and brought to working temperature. Development proper then starts upon a test piece or pieces of the particular length of exposed film stock to be taken in hand. This simply means that a few inches of the end of the exposed roll is snipped off with a pair of scissors and plunged into the developer for a given time. Note in connection with the above, the use of the clock in the dark room, and consequent necessity for its installation. When the time fixed upon in the worker's mind as that which shall be allowed for development of this test piece has elapsed, the short film length is fished out of the bath, rinsed in plain water, and transferred to the fixing solution. When fixed, it is again rinsed, and may then be taken out of the dark room and examined by full day or ordinary artificial light. A single glance will be enough to inform a skilled developing hand as to whether the time allowed to the test strip has been right, or whether this must be altered when dealing with the major portion of the subject from which it was snipped. From such information it should be a simple matter to proceed to wind on the remainder of the film roll and develop it correctly. Such is the technique of the dark room, simple, yet tricky, as one's first attempts will soon serve to show. And now to go over the ground again in detail :—

Developing Baths for Negative Film.

Any bath suitable for negative development in still view work will also serve the purposes of kinematography as far as the actual production of a visable image upon the exposed film is concerned. The amount of developer used in the film developing trough being large (often sixty pints or so for a full-sized trough) it becomes a matter of practical importance that the bath shall be so compounded as to be able to be used over and over again at intervals of hours, or even days, until exhausted. Consequently, developing formulae for motion picture work are usually those in which the keeping qualities of the ready compounded bath are of a satisfactory nature. Kinematograph negative developers should, moreover, be so adjusted as to give a fairly plucky result (one in which the pictures show well-marked contrasts) while yet the reducing power is sufficiently great

for dealing at a pinch with considerable under exposure. Perhaps the best of all developers, taking everything into consideration, is the well-known Metol Hydroquinone, compounded in single solution form :

Metol	2 ozs.
Hydroquinone	2 ozs.
Soda Sulphite	1½ lbs.
Soda Carbonate	¾ lb.
Pot. Metabisulphite	1½ ozs.
Water	60 pints.

There is a special way of mixing the above ingredients, which must be strictly adhered to, or it may be found difficult to get them all into proper solution. Therefore proceed thus :—

First dissolve the soda carbonate and sulphite in half-a-dozen pints or so of warm water. Crush up the metabisulphite small, and make a solution of it in another pint or two of water. Add this to the dissolved sulphite and carbonate. Lastly, stir into the whole the metol and hydroquinone, dissolved in four or five pints of warm water, and proceed to make up the bath to the required sixty pints.

The above bath will be found excellent for the general development of any good, clean-working film stock, always provided exposure of the film in the camera has not been overdone. The temperature at which to use it is somewhere about 66 F., which temperature should invariably be ascertained by means of a thermometer before commencing development. If the worker should find the developer tends in his hands to give too soft a type of negative, the remedy (except where over-exposure is the cause of the trouble) is to cut down the Metol and increase the amount of Hydroquinone proportionately in future brews. One ounce Metol and three ounces Hydroquinone will tend to greater contrast in the resulting negatives, while at the same time considerably cutting down the expense of the bath. Conversely, under exposure in the film, showing itself in the production of " soot and whitewash" negative pictures with choked up high lights and empty shadows, is combatted by increasing the metol content. Another way of adjusting matters which does not necessitate meddling with the bath for future batches of stock, is to warm it up to about 75 F., at which temperature it will be found to work both more quickly and much more softly. At the same time the increased temperature will tend to bring out any latent " chemical fog ", there may be in the emulsion, and where the film stock is not of the best, this may show itself as a light grey cloud, affecting pictures and perforations alike, and more or less defeating the intention of such " forced development" by clogging the very fine shadow detail it is sought to coax out.

Over exposure of the film is dealt with by treating the developer—be it the above or almost any other formula—in quite a different manner. What we do here is to add to the bath a chemical " restrainer," possessing particular action in the matter of influencing slow and contrasty development.

This chemical is Bromide of Potash. The proportion in which to add it to the sixty pint developing bath may be anything from a couple of drachms to as many ounces, according as a slight " clearing " effect or a strong retarding and contrast increasing action is desired. A very satisfactory way of developing very much over-exposed stock is to treat it in the developing trough usually reserved for print development, and which will be found described in the chapter on developing positive film. Yet another and most excellent way of tackling the difficulty of making the best of widely varying exposure is to have two separate developing troughs in the dark room unit. These are placed side by side, and labelled plainly in such a way as to allow of no mistake in the dim red light. One bath contains a developer of the sort already given, and which will give a satisfactory result in the case of normal or slight under-exposure, while the second trough contains a special contrast producing bath for treating over-exposed stock :—

CONTRAST PRODUCING BATH.

Glycin	8 ozs.
Sod. Sulphite	1½ lbs.
Pot. Carbonate	2½ lbs.
Pot. Bromide	1 oz.
Water	60 pints.

The above is also an excellent print developing bath. If found too sluggish in action for the particular brand of film stock in use, the Bromide may be diminished. The converse also applies. Development with Glycin, though slow, produces magnificently clear negatives. For normal to slight over-exposure, use at 66F. to 70F ; for great over-exposure, cool down still further. The Glycin bath keeps better than any other, but its first cost is high.

We append a formula for an alternative quick-working negative developer, and which has the advantage of employing the somewhat cheaper developing agent, Eikonogen, in place of Metol, so that it may, therefore, be preferred by some.

EIKONOGEN HYDROQUINONE DEVELOPER.

Soda Sulphite	1 lb.
Potassium Carbonate	1 lb.
Potassium Metabisulphite	1 oz.
Potassium Bromide	¼ oz.
Hydroquinone	6 ozs.
Eikonogen	3 ozs.
Water	60 pints.

The same general directions apply to the use of the above developer as to the Metol Hydroquinone bath. So much, then, for developing formulae. As has been said before, any single solution bath that will keep, and which is applicable to still view work, may be experimented with by the motion picture worker with every chance of more or less success. But since the inclusion of endless alternative solutions would only serve still further to swell out the all too rapidly growing proportions of the present volume, while anyone on the look out for

developer variations can always find them by the score in works on ordinary photography, we will make no attempt at ringing the changes on developing formulae any further than we have already gone.

Fortunately, fixing baths are all much alike. Below is a composition for one which will serve all purposes well:—

"Hypo"	20 lbs.
Potassium Metabisulphite	8 ozs.
Water	60 pints.

Use quite hot water for dissolving the "hypo," as this salt has the curious property of cooling water down very rapidly during process of solution. The Metabisulphite should, as before, be dissolved by itself, and added after the other chemical has melted in the water. By the way, some readers may be interested to note, in passing, that "hypo"—short for Hyposulphite of Sodium—is really only a nickname for the chemical to which it usually refers, and is not either in its abbreviated or longer form, a proper chemical designation at all. "Hypo" is actually, and chemically speaking, Sodium Thiosulphate, and the writer has never seen any satisfactory explanation of how it came to be called by the epithet denoting a totally different substance which is never, by any chance, used in photography.

We have our baths compounded at last, and it is presumed they are also brought to the requisite temperature of 66 F., and that the washing trough has been allowed to fill with plain water. All is now in readiness for developing the test strips.

Bring the take-up box, containing its roll of exposed film stock into the dark room, remove the cover in the red light, and pick up the end of the film between finger and thumb without, however, removing the roll bodily from the box. Now snip off two lengths, each of them about six inches, and put back the cover of the film-box in place, so that the bulk of the stock is once again protected from all chance of fogging. Next, raise the cover of the developing bath (where two alternative developers are in use choose the one believed to be most suited to exposure conditions as noted in the camera man's note book) and immerse both strips bodily, taking the time of so doing, by the dark room clock. If the bath is fairly new, and reasonably quick acting, and the conditions generally seem about normal, one of the test pieces may be given ten miutnes' development, while the next has twenty. Do not let either of them remain long during the process without a gentle stirring of the solution to ensure fair and equal action upon the emulsion. As each test piece comes to the end of its appointed development time, it is rinsed in the washing trough, and transferred to the fixer, where five minutes' immersion should be amply sufficient to complete the necessary chemical treatment. The method of judging whether fixation is complete is however, as follows:—

Turn the film round and look at the celluloid side. If it is not completely fixed, the emulsion will be seen from the back to retain some, at least, of its peculiar milky appearance, characteristic of the

THE APPEARANCE OF GOOD AND BAD NEGATIVES.

We have tried by means of these half-tone blocks to give a comprehensive idea of negatives of various descriptions.

FIG. 43.
Under exposed and under developed.

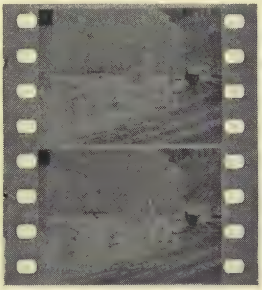


FIG. 44.
Hopeless under exposure. Note film perforations fogged through forced development.

FIG. 45.
Under exposed and over developed (soot and whitewash).

FIG. 46.
Very bad negative, under exposed and scratched by a dirty gate to the camera.

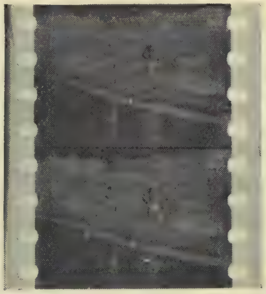


FIG. 47.
Over exposed, but correctly developed. Result flat.

FIG. 48.
Correctly exposed. Soft (rather short) development.

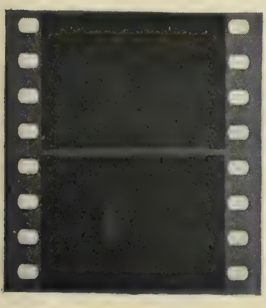


FIG. 49.
Exposure correct, but film much over developed.

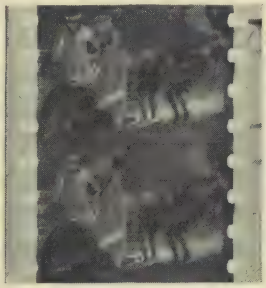


FIG. 50.
Correct exposure. Full (rather long) development.

FIG. 51.
Film fogged by daylight entering film box.

original undeveloped film stock. Upon complete fixation all that look goes, and the film takes to itself the usual clear appearance of an ordinary kinematograph positive, except that in a negative film the objects which are light in nature will appear dark, and *vice versa*. Thus a good negative of a snow scene should show both foreground and sky,nearly black, while dark tree trunks and such like would appear white. The general and distinctive characteristics of both good and bad negatives will, however, be plainer upon reference to the plate on the previous page giving reproductions of typical developed test strips.

Once the worker knows what a good negative should apear like, it will be but a matter of moments to see whether either of his test pieces approximates to the ideal, and if not, in what way it may be improved. Suppose, for instance, the ten minute piece is not quite "plucky" enough, while the high lights in the twenty minute piece—and which high lights will be rendered dark, remember—are choked, then it follows that a development time between the one and the other is what is needed. Thus fifteen minutes would here be the required development time for the main portion of the given subject. Or again, both test pieces may show over-development, coupled with a want of contrast. In that case over-exposure is the cause, and remedy will lie in the special restrained and alternative developing bath, if such a one is kept handy, or if not, recourse must be had to a liberal dose of Potassium Bromide in the normal working developer. In either of the latter cases further test strips must be developed under the new conditions until the best way of treating the particular film length has been arrived at.

If the twenty minute strip shows want of density, it means one of two things; either the bath is old and wants renewing, in which case it will be found on examination to have gone brownish in colour, or the negative in question has been greatly under-exposed, the treatment then being to warm the bath to at least 75 F., or even higher if the gelatine of the film will stand it (80 F. is the highest one ever dares go to). A test piece is now allowed to remain in the warmed solution for half to three-quarters of an hour, that time being about the longest the emulsion will stand in a warmed quick-acting developer without bad chemical fog. If, on withdrawal, a satisfactory image does not show itself, the subject must be looked upon as well nigh hopeless. A chance for it may still lie in the after treatment known as intensification. Develop up all you can, fix and wash according to the directions about to be given in this chapter, after which turn to the chapter on after treatment wherein intensification methods will be found. This gives an idea, at least as to how to be guided in the treatment of the film from examination of the test strip. And now comes the question of developing the main portion of the subject according to its revealed requirements.

In the case of pin frame development, the film has first to be wound over the pins. This must be done in order to treat successfully

the full length subject in the limited compass of a comparatively small developing trough. The following is a suitable method of setting about it :—

First, take from a box of them, which should always be handy in the dark room, a couple of steel pins. Don't try to use the common tin ones, as they bend and cause a lot of trouble. Steel ones are on sale at any drapers. These pins should be stuck in the lapel of the coat, where they can easily be got at. Now place a pin frame on the winding table and again remove the door of the charged take-up box, but this time the contained film is bodily drawn out, still in the form of a roll, having for its centre its internal spring hub. Take the roll in the left hand, with the film winding away, upwards from the bottom of it, in which position the celluloid side of the unrolled end portion of film will be towards you when this is being drawn upward, as in figure 52. The very top of the film end is now folded down and

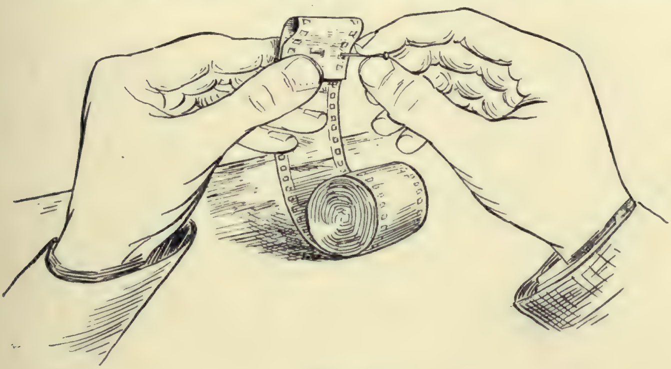


FIG. 52.

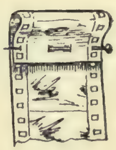


FIG. 53.

backward for about an inch, and one of the pins run through the two thicknesses, thus forming a loop as in figure 53. It is this loop which is next slipped over one of the four innermost pins of the pin frame, taking care that the way it is placed on and direction of winding are such that the **celluloid and not the emulsion side of the film shall lie against the pins.**

The business now before us consists in getting the film correctly wound on the pins, in spiral form, with due regard to the proper utilisation of each pin once, and none of them twice over, as we go round and round. Now this winding may be set about in two ways, either the pin frame may be suffered to remain stationary upon the winding table, while the film roll is passed round from hand to hand, or the film may be held more or less stationary in one hand, while the pin frame is rotated with the other. In the latter case it will be necessary to have a spindle of suitable length (a large nail with its head cut off will do) driven into the table so that the central hole in the frame will fit easily over it. If the frame is arranged so that one of its our arms sticks out somewhat from the table top when placed over

the spindle, it will be an easy matter to steady its movements as required by allowing the body to come in the way of this projecting arm while the film is in the act of being placed over the pins. The body is drawn slightly backward, while the disengaged hand gives the frame a quarter turn. Then, once more the motion is similarly checked for further winding. Such, at any rate, is a simple mode of tackling the winding difficulty, which may otherwise come upon the novice as somewhat formidable. In any case the thing is to remember that what we have to do is to get the frame wound tightly, and with the film right way about, so that the celluloid and not the emulsion side touches the pins. We must learn to do this, and to do it in reasonable time, and for that there is nothing like practice with spoilt or old positive film till skill is acquired.

When the subject length has been wound off, or in the case of two or more subjects being taken on the same length, when the film has been wound to the point where a scissor snip or punched out hole announces the fact of a change of picture, we proceed to complete operations by making a second loop with our second pin, for which purpose we cut the film at the punch mark, if necessary. This second loop is slipped over the nearest pin, making sure that no slackness of film is allowed in the process, and the frame is then wound and ready for immersion in the trough.

The secret of managing the wound and wetted film from this point is to remember that the agency of the developer and subsequent washing and fixing baths will cause not only the emulsion, but also the celluloid base itself to swell. Hence, even in the case of the tightest wound film, the commencement of development is bound to cause it to become more or less slack upon its supports, and so it must be treated accordingly. For instance, in order to obtain equal development and freedom from the effects of air bells accidentally adhering to the emulsion after its immersion, it will be necessary to keep the frame agitated more or less from the start. On the other hand, too much of this while the gelatine coating is still in an only half saturated and therefore sticky condition will cause the outer turns of film to sag together, producing patches of undeveloped film here and there. The matter is one calling for both care and practice in manipulation.

At the same time a few ideas may be given as to a method of going to work which meets the case. In the first place, when making up the developer see that there is enough of it in the bath to give a full half an inch depth above the top edge of the immersed film. If this is attended to it will be found that immediately after the first introduction of the frame into the trough one can raise it slightly once or twice, letting it fall back again with a slight bump upon the trough's bottom, and thus detaching all large airbells effectually. Care must be taken when doing this not to lift it to a point at which any portion of the wound film is out of the developer. Nor after the first ten seconds should any further treatment be given the film in the way of such agitation for quite another minute after development starts.

At the end of that time take hold of the frame by its central boss and lift it bodily out of the trough once or twice, plunging it back again each time. This action will deal with all airbells which may happen to be remaining, and at the same time set up currents in the developer which will stir it effectually. By repeating the up and down treatment, say once each five minutes, a successful development should be assured. Upon expiration of the appointed time the frame is finally lifted out and given a similar agitation in the washing trough for a space of about twenty seconds or so, after which it goes into the fixing trough.

Agitate the film again in this, once or twice, leaving it in altogether for ten minutes, after which it will be thoroughly fixed. A final wash in the washing trough, lasting over at least an hour in ordinary cases (a quarter of the time may be made to serve for topicals) completes the cycle through which negative film should normally pass ere it finds its way to the drying drum.

Since the object of this last washing is solely to free the wet gelatine of the " hypo " it has absorbed out of the fixing bath, it is of the utmost importance that the water changing arrangement should be properly installed, and of an efficient character. In the case of work on any considerable scale, it will be found necessary, in practice, to build special troughs or tanks for this final washing process, so as to avoid having to hang up work in the dark room for an hour or more at a time after the fixation of each film length. Extra washing troughs or tanks for this purpose will not have to be placed in the dark room at all. Any convenient corner will suit. The syphon arrangement, already referred to, is, however, of the greatest importance in the process of efficient washing. Accordingly, a diagram is here given showing in detail the system employed, and from which it is hoped the reader fitting up negative developing plant will have no difficulty in making his own adaptations to individual requirements.

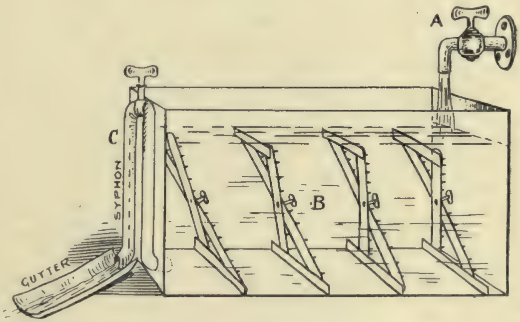


FIG. 54.—SYPHON WASHING TROUGH.

Fig 53 shows a suitable washing arrangement for a number of pin frames at a time. " B " is a tank in which the frames can be immersed and held in a sloping position by suitable rails and stops, as illustrated. The water tap "A" provides the washing water flowing into the top of the tank, while the syphon " C " removes impure and used water from the bottom. Now were "C" a simple syphon, one of two things would happen when it started (which takes place automatically by the tank becoming ful since, since the top bend of "C" is below the level of the tank walls). Either the syphon would take off less water than the tap supplied (supposing it to be a syphon of small bore) in which case there would be a general overflow, or else if the syphon were of greater capacity than the delivery the reverse would occur, and the tank would empty itself completely. In practice both these eventualities are avoided by having a small air inlet at the top of the bend of the syphon tube. This inlet is controlled by a tap and is normally left open.

Under such circumstances, the syphon acts as a simple waste water pipe, with the exception that it is fed from the impure water at the bottom of the tank, thus causing efficient circulation of the contents. When, on the contrary, it is required to clean out "B," as should, of course, be done periodically, this is accomplished by closing the tap controlling the air inlet to the syphon, and turning on "A" full. "C" now acts its part as a true syphon, and by turning off "A" once again after the overflow has once started, the tank will empty itself completely.

Should "C" show signs of becoming choked with gelatine from the emulsion of the films washed in the tank—as strangely enough does happen occasionally, even though it is only cold water which is used for washing—the treatment is to open the air inlet and insert a small funnel, down which boiling water is poured till the obstruction is cleared away.

This completes all that need be said regarding the extremely important item of washing kinematograph film, and be it set down here, neither negative nor positve stock which has been scamped in this particular can possibly remain in good condition for any length of time. Even when a valuable topical negative has had to be unduly hurried for its first printing a second and thorough washing of it should be undertaken at the earliest opportunity, if it is likely to be of value on a future occasion.

One word, also, on a subject intimately connected with the above since it concerns the other great factor governing permanency in photographic work—the activity of the fixing bath. If the fixing bath is not active, fixing cannot be thorough no matter how much it is prolonged, and no film imperfectly fixed will ever remain permanently clean and free from stain. Therefore, adopt the following rule in the matter of checking the fixing bath, and do not depart from it.

Always give your test strip, by which you find the development period for the film subjects, one definite time in which to complete fixation, and let this time be exactly five minutes. Also see that the strips get an occasional stir up in the bath, which latter should not be below 60 F. at least. While such time suffices completely to clear away all visible milkiness from the short test lengths of film, it may confidently be reckoned that double the period, or ten minutes, will be ample fixation for the regular wound lengths. The moment a test strip shows signs of being under fixed after five minutes' immersion throw the bath away and compound another. Thus can one be certain of keeping on the right side of fixation.

Film drying, though seemingly simple, is considered by the writer worthy of a little chapter to itself, and this it will have in due course.

CHAPTER VIII.

POSITIVE MAKING OR PRINTING.

So far in this first section of our present work we have dealt with the practical side of taking and developing kinematograph negatives. In the negative the respective values of light and dark are reversed. In order to bring these values back to what they are in nature, it is necessary to "print" a positive from our original negative picture. It is not difficult to follow the reason for the reversal of tones in a kinematograph negative when we remember that the photographic image is formed of a deposit produced by the action of light coming through the camera lens. Naturally such deposit will form most where the light action is strongest; in other words, the lightest natural objects will give the darkest deposits on the developed film Thus the reason of the freakish appearance of the negative is fully explained. At the same time, we all know that in both the still photograph and kinematograph film as exhibited, all this topsy-turvydom of tone values has been got over. Also it will be common knowledge that a scene has to be photographed only once in order for many copies of it to be easily obtainable.

It is to the process of "printing" that we must look for the explanation of both these latter facts, and thus the art of "printing" or positive making takes rank in all photographic work, whether moving picture or otherwise, as second only in importance to the production of the negative itself.

The "printing," or production of a positive from a photographic negative can be very simply described. In the first place a sensitive photographic surface has to be provided capable of being acted upon by some suitable light to an extent enough and not too much for convenience sake when worked under printing conditions. Once we have such a sensitive surface of suitably toned down light recording capacity—known technically as a positive printing surface or "positive stock"—the actual modus operandi is of the easiest. All that is necessary is to place a negative over the face of the positive emulsion and then expose the latter to light through the former. In this way the image upon the negative will act as a shield of variable density, allowing more or less light to penetrate and act upon the positive stock, according as the opacity of its various parts. Thus, suppose a negative of a target be placed before a piece of positive stock and light then allowed to stream upon the face of it. A target consists in its simplest form of a white outer rim and black bull's eye, so that in the negative these will be the other way about. That is

to say, in it the bull's eye will be transparent and the outer rim opaque. Consequently, when the light strikes the face of this negative, behind which a piece of positive stock is pressed, the rays will be able to penetrate through the centre or bull's eye portion, while being kept from getting through the black deposit constituting the outer rim. Now suppose the exposed positive to be developed. Naturally, the part which has seen light will be the only part to take a deposit of silver, and that part will now be the area which lay behind the transparent negative image of the bull's eye. The rest of the positive having been shielded from light action by the deposit on the negative will refuse to develop at all. So by process of printing we get once again an accurate reproduction of the target as it was originally, not a negative this time but a picture showing the black centre and outer rim white as it ought to be, in fact, a positive or "print." Further, since by putting the negative to the foregoing use it has not been altered of itself in the least, it follows that we shall be able to repeat the process of making duplicate positives as long as we wish, or as long as the supply of positive stock holds out.

That is just the process we have to embark upon in order to get from our kinematograph negatives useable pictures, showing correct tone values. And now to actual ways and means.

Positive stock for kinematography is sold in rolls, just as is the similar article used for negative production. Film, whether positive or negative, looks practically speaking identical to the eye. In reality, positive film is of much less sensitiveness to light than the negative stock. It also has the quality of producing great density in the shadows with comparative ease, while at the same time preserving clearness and purity of high lights far better than would negative stock under like circumstances. In fact, to sum it up in a few words; whereas negative film is suited primarily for negative making, positive film is manufactured solely for use in printing. Both might be used for the process for which they are not intended and both would then work in an inferior manner.

Let us turn to the consideration of how we are going to take in hand the actual printing of a kinematograph positive. Firstly we shall have to contrive some arrangement by which the dry negative film may be held close against the positive stock, while light is allowed to stream through the successive pictures on the former, so as to produce positives accurately spaced and equally exposed upon the latter. Practically speaking, there is only one discovered way of satisfactorily accomplishing this task. That is by employing an arrangement similar in principle to the escapement of a kinematograph camera whereby positive and negative film are pulled face to face through a gate behind the mask of which a light burns, thus effecting exposure. In order to make use of the positive film in this way it is imperative that it shall be perforated as was the negative stock.

Such an apparatus as the above for automatically exposing positive film behind the negative, is known by the name of a "printer." Formerly "printers" on the market were of two kinds—the continuously moving film "printer" (in which negative and positive film were drawn slowly and continuously face to face before an illuminated slit) and the "step by step printer." The step by step system is the one already referred to in which a form of claw movement actuates the two films on an intermittent principle. Now-a-days the latter class of instrument has, by common consent, taken the field as the only really reliable one. It is therefore the sole kind we shall trouble to describe in detail. The arrangement of the various parts of a "step by step printer" are shown diagramatically in figure 55.

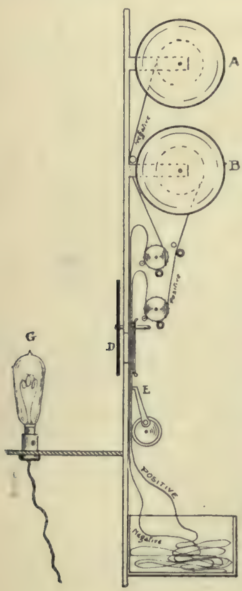


FIG. 55.

Here "A" represents the roll of negative film to be printed from while "B" is the positive stock to be printed upon. Next come sprockets over which the films pass and which give a continuous feed of the faced films to the gate "D," while the claw "E" pulls the films down by means of the now familiar intermittent escapement. "G" is a light source which is in practice suitably enclosed so as not to shine forth broadcast in the dark room where printing is to take place, though here the lamp is represented as open, while there is filled between it and the gate a revolving shutter exactly similar to and having the precise function of the shutter of a kinematograph camera, namely, to cut off light periodically from the light source and so prevent its striking the film during "change." It will follow, that after each pull of the claw "E" as the shutter rotates out of the way of the lamp, light will fall upon the negative behind the gate mask. Passing through the silver negative deposit in ratio to the density of its various parts, this light will correspondingly affect the sensitive positive film behind and held close against the negative. After exposure lasting a suitable time (say the one-sixteenth or one-twentieth of a second) the continuing action of the mechanism will cause the shutter to cut off the light again, after which the claw "E" once more operates the double thickness of film, so bringing a new negative picture and unexposed positive surface before the mask for exposure.

The annexed plate (Fig. 56) gives an excellent idea of an actual commercial type of "printer," designed to be self-contained and suitable for use at high speed and large output when connected up with the electric

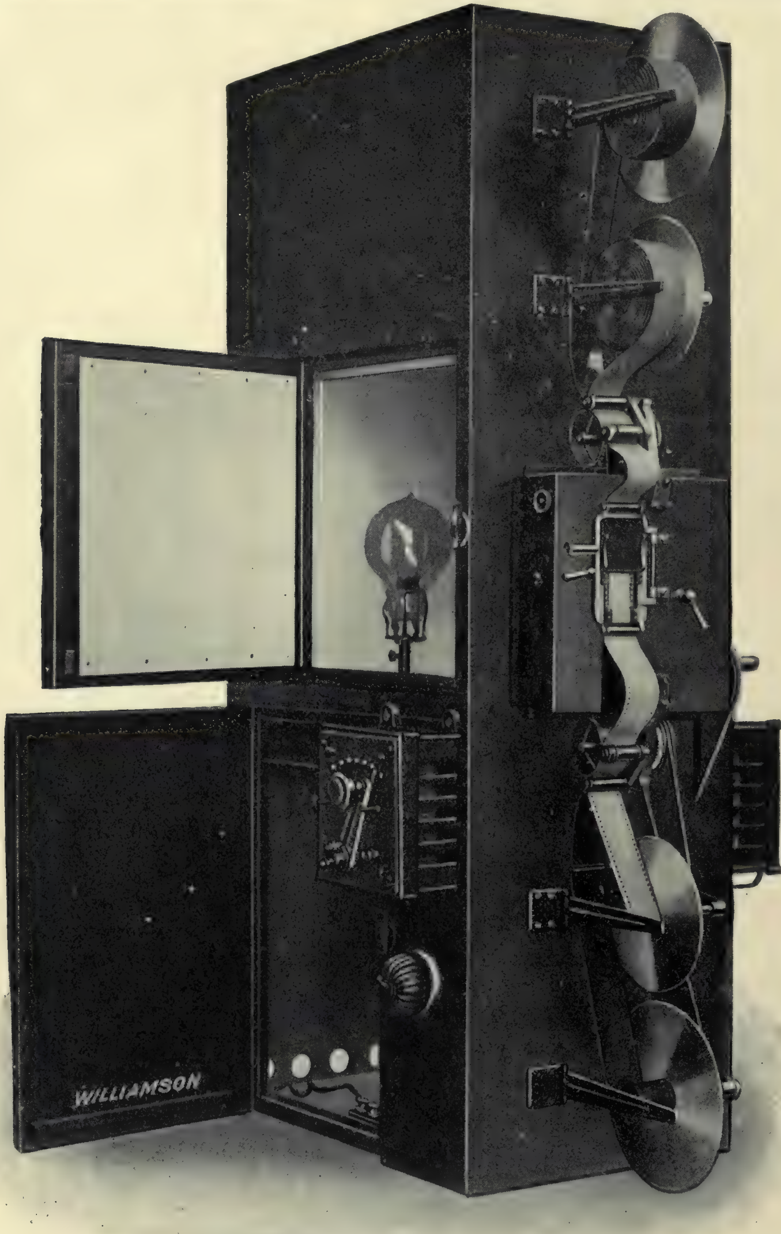


FIG. 56.—WILLIAMSON'S MOTOR DRIVEN PRINTER.

wiring of the establishment. A few moments spent in explaining this particular commercial printer should put the reader well in possession of the general working details of the whole class of them.

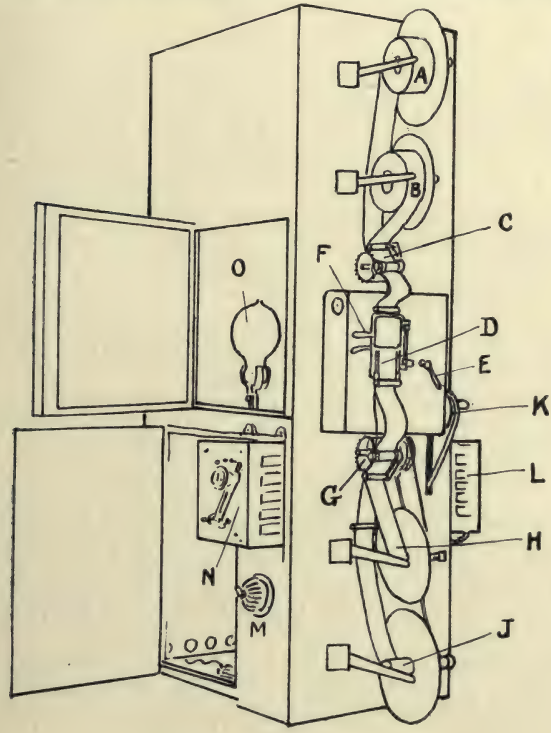


FIG. 57.

Key to Photograph of Williamson Printer.

Reference Table :

A Negative Spool.
B Postive Spool
C Top Spocket.
D Gate.
E Lever controlling ruby glass light cut-off;
F Gate adjustment.
G Bottom Sprocket.
H Positive take up.
J Negative take up.
K Motor drive.
L Rheostat controlling same.
M Switch.
N Light Dimming Resistance.
O Printing Lamp (electric)

First as to the light source. It will be seen to be an electric lamp of the " focus " type. This is contained in a chamber which is light-tight upon closing the side door at the middle of the printer cabinet. Thus the rays from the printing light are prevented from coming out into the room (which must of course, be " dark " in the photographic sense) and producing general fog upon the roll of positive stock seen fixed in position upon the spool holder nearest above the gate. The actual light allowable in the kinematograph printing room is bright orange or even a pure yellow (See Safe Lights. Chap. 5, part 3). The topmost spool holder holds the roll of negative which is to be printed, and in threading the machine, it is of the greatest importance to make sure the emulsion surface of the downward dangling negative film end is towards you, whilst that of the positive stock is away from you when the two rolls are in place So spooled, the faces of negative and positive film stock will be together as the two pass over the sprocket, figured immediately above the gate, and the function of which is to maintain a constant loop of the double film to feed the escapement.

The escapement, invariably some form of the already described pin or claw action, is in the machine at present under discussion enclosed in the box to which the gate and mask are fixed, while the lowermost and next to lowermost spools of all are the rewind or take up spools for respectively negative film and exposed positive stock.

The lower door of the printer, also shown open in the illustration, gives access to a small electric motor, controlled by the starting switch and rheostat, seen attached near by to the side of the light-tight cabinet. The actual mode of working the printer should now be fairly plain. For the sake of completeness we will, none the less, give a brief description of the actual printing of the film length.

Having first taken careful note of the density of the negative we are about to print, we adjust the light of the focus lamp accordingly. This is done in two ways; either we can push the lamp nearer to or farther from the gate of the printer by means of an external rack motion or we can cause the filament to burn brighter or less brightly by altering a variable resistance fixed on the opposite side of the cabinet to the one shown; or we may make use of both means of exposure adjustment. For a normal negative, about three-quarter power of a fifty candle power focus lamp at a distance of six inches or so will do with the motor rate so adjusted as to print from eight to twelve pictures a second. Soot and whitewash negatives may be partially corrected by giving short exposures with a higher printing rate and brightly burning lamp brought close to the gate, whereas a low printing rate and dim light pushed well back from the face of the gate will tend to the production of greater contrast in prints from flat negatives.

The actual threading of the double thickness of film into the gate is just as when threading a single film into the camera, except that it is necessary to take a little care over making sure the claw of the intermittent motion gets grip on the double thickness through superposed perforation holes. Also in a printer there is an adjustable printing mask, which is set by means of a rack screw, just as with most projectors. While adjusting this printing mask and up to the moment of printing, a lever is turned, which lets down a ruby glass light interceptor between the light source and the negative film. All preliminary adjustments can thus be made with ease and accuracy without fogging any film the while. The masking is satisfactory where the whole of one picture and nothing of either of the others appears in the gate between each pull of the claw, which is to say at the "uncover" position of the rotary light shutter.

The film threaded, all that is now necessary is to connect the ends of positive and negative film to their respective take-up spools, after passing them together over the bottom sprocket. The actual printing takes place by first starting the motor to the speed determined upon, and immediately turning the lever that controls the red glass light interceptor, thus throwing the latter out of the way. All being well,

the machine will now proceed to print merrily on till the negative length is passed completely through, and rewound upon the take-up spool. The light interceptor is then turned back into place and the positive stock cut off short from the roll of any remaining unexposed film, which may still be on the upper positive spool. The printed positive is boxed in a light-tight case and sent to the developing room.

It will be seen from the above that as far as the mechanical side of printing goes it is simplicity itself. All that is necessary from that point of view is to keep a sharp look out on the take up and sprockets to make sure they are doing their work. It is in the judging of the correct brilliancy and distance of the light source, also the proper speed of motor needed for each negative of varying density, that the real art of high-class printing lies. Nor is it any mean acquirement either to be able to get the best or even something near the best out of each negative that comes along to the printing room. Here, again, as before, the only advice which can be given to the novice is to avail himself of any tips he may be able to get first hand from the actual watching of an expert printer at work, or failing that to practice printing test lengths of positive from various negatives each possessing definitely different characteristics until he has worried out for himself the knowledge of how to gauge results beforehand.

We must not forget that this book has set out to cater not only for the man desirous of going into the kinematograph trade in a fairly large way, but also for the one whose ambitions are more modest; too modest perhaps for him to run to the expense of a printer such as already illustrated. These more modest aspirants may install a small hand printer at comparatively trifling cost. A hand printer is simply a printer as described but minus the motor driving arrangement and also such other expensive attachments as can by any means be dispensed with. For instance, both the light-tight cabinet and the rewinding spools with their gearing can be done without. The first economy is effected by affixing the printer to the inner side of the dark room wall, in

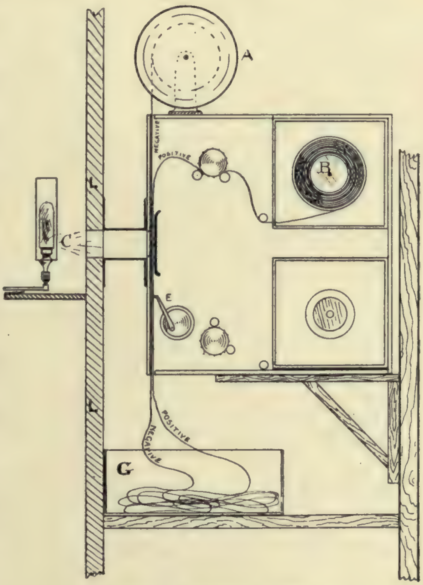


FIG. 58.—A HAND PRINTER.
Camera as arranged for printing. A shows negative film roll feeding through slot in camera top. B box holding positive stock. The positive and negative pass out (after printing) through the slot in bottom of camera and into box G. L, L, wall of dark room through hole in which light reaches film from light source.

which is cut a small hole allowing of light coming to the gate from a suitable light source outside the room. The absence of rewinding arrangements for negative and positive film may be compensated for by providing a large clean box into which both films fall after leaving the gate. A hand printer is fitted with a handle for operation, just as is the kinematograph camera itself. The writer has met a man high up in the motion picture trade who boasts that he has turned out as much as eight thousand feet of positive in a day's working, single handed, with such a hand printing arrangement as above described, the cost of which to buy would certainly be well under £20. At a pinch, even, it is not absolutely necessary to possess any printer at all, provided the kinematograph photographer only has need of a small and occasional output of positive from his negative stock, as when he does an occasional print for some local picture hall. In this case the camera itself may be utilised for the purpose of positive production. The annexed diagram, figure 58, shows the method of doing this. For the purpose the camera has to be provided with slots both top and bottom. Where it has not got these they can be fitted at small cost without in any way hurting the instrument for its usual work. Needless to say, these slots must be provided with efficient sliding metal light-tight coverings which are only removed for the purpose of printing as about to be described. At all other times they remain firmly closed. To print a positive in the camera the negative film is placed over any simple bobbin support so arranged as to hold it above the top slot, as at the position "A" in the diagram. This negative film is then threaded through the top slot and the gate, and out of the bottom slot through a suitable aperture in the bench supporting the camera, till it falls into the containing box "G." Note that the negative must be threaded with its emulsion side facing the camera back; also that it is put over neither of the sprockets. The positive stock to be printed upon is enclosed in the top film box "B" from whence it is passed over the top sprocket. It then travels through the gate, and out at the bottom slot, face to face with the negative. Note also, that for printing, neither the bottom camera sprocket nor the take-up box are made use of at all. "L" is the dark room wall, in which has been cut a hole of such a size and in such a position as to admit light from the light source (in this case figured as incandescent gas) straight through the lens jacket to the gate.

The Lens itself must be removed when printing.

The diagram does not show the light shutter of the camera, which is, however, in place, fully open, and working as usual.

So arranged, the camera will be found to act as an efficient hand printer, and be it understood the work turned out by it, makeshift though it is, need not be distinctly inferior to that produced by the regular electrically operated machine hitherto described. Of course camera printing is less quick and convenient than when working

with the proper article. Also pains must be taken to turn the handle at an even and uniform rate for any given film if even exposure is to be the result. As before, too great or too little density of the negative is compensated by turning the printing light up and down, or moving it nearer to or farther from the dark room wall; also by alteration of printing rate. Care must be taken in operating such a contrivance as the above, to see that the printed film and film negative do not stick together at any time when passing through the bottom slot. For this purpose the camera door is kept open, while a bright orange light in the printing room enables one to see the first signs of such sticking, should it occur, and to counteract it by stopping, turning at once and pulling the slack film down into the receptacle " G."

Note.—Camera printing is only possible from negatives taken with the actual camera employed for the positive production, or from other negatives possessing identical " masking." See appendix to this part.

A few definite hints as to safe and useful illumination of the printing and print developing rooms may not be out of place here. Positive film, being much less light sensitive than negative stock, the printing and print developing rooms may safely be illuminated by either pure red or orange red light. Even bright lemon yellow may be employed, provided the yellow is spectroscopically tested and found free from admixture with rays from the " actinic " end of the spectrum, but in practice yellow illumination is usually risky, since samples of commercial glass of this colour invaribly pass as well a goodly proportion of the photographically active blue and violet light rays. For further remarks on colour testing, and making of spectroscopically accurate colour filters for dark room purposes, see part III. of this book, end of chapter on colour kinematography.

Having exposed our positive in the printer, the next thing is to develop it.

The technique of print development is practically the same as that of negative development, except that since the light permissable in the print developing room is comparatively bright, it is relatively easy to judge when the positive image is dense enough by simply taking out the frame from the bath and looking on the face of the wound print. Thus test strips become a needless luxury (not to say time wasted) in positive production. This, of course, applies only to the man with some knowledge of the work. For the novice the more tests he can make for himself to begin with, the less good film lengths will he spoil. We have already said in the previous chapter that the developing bath for prints is usually compounded differently to that for negative work. Accordingly, we append some formulae for positive development. The first gives fair density and keeps well.

Hydroquinone	8 ozs.
Soda Sulphite	3 lbs.
Soda Carbonate	3 lbs.
Potassium Bromide	½ oz.
Potassium Metabisulphite	1 oz.
Water	60 pints.

The above bath may be made to work more quickly and give softer results by increasing the amount of Soda Carbonate, or it may be slowed down and at the same time caused to give greater contrast by increasing the proportion of Pot. Bromide.

Another print developing bath which will be found to work more quickly and vigorously than the above, though liable not to keep well is the following:—

Hydroquinone	12 ozs.
Soda Sulphite	3 lbs.
Potassium Bromide	½ oz.
Caustic Soda	6 ozs.
Potassium Metabisulphite	1 oz.
Water	60 pints.

The Glycin developer recommended for treatment of over exposed negative stock in the previous chapter is also excellent for positive film. The remarks made in connection with the other formulae regarding adjustment of the respective Carbonate and Bromide contents for varying degrees of vigour in the produced positives apply here as well.

It may further be added for the benefit of those desirous of experimenting in variations of the bath ingredients that the component parts of all ordinary developers may be summed under four heads, thus:—

THE REDUCER.

This is the actual developing agent itself, of which there are legion. Among them may be mentioned such well-known ones as:—

Hydroquinone (syn.: Quinol)
Metol
Eikonogen
Glycin
Pyro
Amidol
Ortol, etc., etc.

The actual developing agent is, in fact, any chemical possessing the property of attacking the silver bromide of the photographic emulsion where the latter has received light action and reducing it to metallic silver. Hence the name. In order to prevent this "reducer" spontaneously decomposing by oxidation when made up in solution, there is added to the bath a

PRESERVATIVE.

which may be

Soda Sulphite
Potassium Metabisulphite
Citric Acid
Dilute Nitric Acid, etc., etc.

This preservative hinders the action of the reducer upon the film's emulsion at the same time as it prevents spontaneous oxidation, which hindering effect is got over and the work of the developer upon the photographic film rendered effective by an

Accellerator.

Accellerators are

Soda Carbonate
Potassium Carbonate
Caustic Soda or Caustic Potash
Formalin, etc., etc.

In the case of the developer Amidol (which gives very fine results upon positive film though the bath will not keep) Sod. Sulphite acts both as preservative and accellerator combined. Finally, to give the worker control over the rate and character of developing action, as also to avoid tendency to chemical fog production (where the film stock is given to showing signs of it) the bath's chemical contents are completed by the addition of a small quantity of

Restrainer.

This is nearly always Potassium Bromide (written short, Pot. Brom.)

Sometimes, for special purposes, other Bromides, such as Ammonium Bromide are employed, as for instance when sepia tones are desired upon positive film by the development of greatly over-exposed stock in a bath strongly restrained with the latter salt. Potassium Citrate is also occasionally used.

With regard to the use of other developers beside those for which suitable formulae have been given, we can only repeat what we said in connection with negative baths. The reader may experiment if he likes, and if so will find untold numbers of alternative formulae for all imaginable processes in connection with photography in, for instance, such a well-informed photographic encyclopaedia as the *British Journal Almanac,* published by the proprietors of the *British Journal of Photography.* For the rest we will only add that sometimes a Metol Hydroquinone positive developer may be useful under certain conditions. Where such is used it may be made up according to the regular negative developer formula given previously, only for positive film this should be of double strength and with the addition of at least an ounce of Pot. Brom. to the working bath.

The actual development of positive film is precisely like that of negative film with the already noted exception that completion of the process is judged by lifting the wound frame out of the bath and examining it before a good bright non-actinic light. Fully developed but unfixed positive film should show the pictures seemingly over dark, while still the unexposed emulsion around the perforations remains milky white as when first placed in the solution. If further,

on holding up the wound pin frame to the light so that a portion of the film can be looked through, the pictures are seen to stand out both dense in the shadows and plucky in the high lights, it may be taken that development is complete, and should be stopped forthwith. But here, as in everything else that has to be learned, practice and nothing else will bring mastery of the secret of correct judgment.

Development ended, the film is rinsed, fixed, and finally washed free from "hypo," just as in the case of negative stock.

The fixing baths for negative and positive film are of the same composition.

A SIMPLE CHEMICAL TABLE FOR KINEMATOGRAPHERS.

Common Name.	Correct Chemical Name.	Solubility in 100 parts of water at ordinary temperature
Carbolic Acid	Phenol	6½
Citric Acid	Citric Acid	130
Salts of Lemon	Oxalic Acid	10½
Picric Acid	Tri-intro-Phenol	1
Pyrogallic Acid	Tri-Hydroxy-Benzine	44
Alum	Hydrated Ammonium Aluminium Sulphate	12
Chrome Alum	Hydrated Chromium Aluminium Sulphate	16
Ammon. Brom.	Ammonium Bromide	72
Carbonate of Ammonia	Ammonium Carbonate	25
Persulphate of Ammonia	Ammonium Persulphate	65
Chloride of Calcium	Calcium Chloride	400
Slaked Lime	Calcium Hydroxide	⅛
Blue Vitriol	Copper Sulphate	40
Eikonogen	Sodium Amido-Betanaphthol-Beta Mono-Sulphate	4⅕
Hydroquinone (Quinol)	Para-di-dydroxy-Benzine	6
Iron Chloride	Ferric Chloride	160
Iron Ammonia Citrate	Ferric Ammonium Citrate	25
Nitrate of Lead	Plumbic Nitrate	50
Epsom Salts	Magnesium Sulphate	100
Corrosive Sublimate	Mercuric Chloride	6¼
Vermillion	Mercuric Iodide	⅛
Bichromate of Potash	Potassium Dichromate	10
Bromide of Potash	Potassium Bromide	65
Carbonate of Potash	Potassium Carbonate	112
Citrate of Potash	Potassium Citrate	166
Red Prussiate of Potash	Potassium Ferricyanide	40
Yellow Prussiate of Potash	Potassium Ferrocyanide	29
Caustic Potash	Potassium Hydrate	200
Iodide of Potash	Potassium Iodide	140
Permanganate of Potash	Potassium Permanganate	6¼
Pyrocatechin	Ortho-dyhydroxy-Benzine	80
Lunar Caustic	Silver Nitrate	227
Borax	Sodium Botate	8
Washing Soda	Sodium Carbonate	63
Salt	Sodium Chloride	35
Hypo	Sodium Thiosulphate	170
Vanadate of Soda	Sodium Vanadate	200
Bromide of Strontia	Strontium Bromide	100
Thiocarbamide	Thiocarbamide	9

CHAPTER IX.

TINTING, TONING AND TITLING POSITIVES.

Tinting a kinematograph positive film is in reality not a chemical process at all, but a physical one. It is no more than dipping the film into a bath of dye whereby the high lights of the print become tinted to the colour of the dye bath. The tone of the silver deposit remains absolutely unchanged by such treatment, only where such deposit is light the dye absorbed by the gelatine of the film will show through, thus giving to the whole a semi-toned appearance at the same time as the clear parts of the film take on a more or less strong tint of the dye colour.

We append a table of well-known tinting effects, together with the baths and approximate strengths used in their production. It will be understood that the brand of film and state of the gelatine—due to varying time in the developer, hardening or absence of hardening, etc.—will have a great deal to say as to the amount of dye absorbed in a given time for any given strength of tinting bath, so that only trial on a spare inch or two of the actual film can show what time of immersion will give the correct result aimed at.

Moonlight effect	The Positive must be somewhat thin and showing no sharp cut shadows. Tint in quarter per cent. (1 in 400) patent blue dye solution.
Candle light and lamp light effects.	Strongly printed film. Usually an interior subject. Tint to a full yellow brown colour in one per cent. Bismarck Brown.
Firelight effect.	Tint in one per cent. Eosine solution. Subject must be specially photographed so as to get the light properly concentrated if the effect is to be good.
Weird and murder scenes	These are heightened by tinting the film faintly green in a half per cent. acid green bath.
Early morning	Give the film the faintest pink tint by immersion in a one eighth per cent. bath of Rose Bengal, followed by washing till colour is very slight.

All the above dyes are easily obtainable, as are also a number of others, ranging through the whole gamot of colours from lemon yellow to purple, and which may all be employed for producing experimental tinting effects. Whatever dye is used, and for the production of whatever strength of tint, the rule to follow is: firstly, so to adjust the concentration of the bath that the film may remain at least

five minutes in it without great excess of colour absorption over what is wanted. Secondly, after the film is tinted wash it for at least thirty seconds—preferably a minute or more—in plain water (which need not be changed) before setting to dry. This will discharge some of the colour, and that must be allowed for when tinting, but it will also prevent streaks of varying colour intensity in the final result. The short wash will also save the drying drum from becoming unduly charged with various dye colours used in the film tinting.

Probably some small film producers may not wish to go in for film tinting as far as their subjects are concerned, but may yet wish to tint their titles as a measure of eye protection for the audience and by way of enhancing the brilliancy of the pictures which follow on the screen. To such it may be interesting to note that short lengths of title film, up to say twenty feet, can be successfully tinted by simply running the film length backwards and forwards in a small dish containing strong dye solution, as shown in figure 59.

FIG. 59.—FILM TINTING IN A SMALL WAY.

"D" is the work bench, which must be clean and free from chemical taint. "C" is the small dish of dye, through which the worker pushes the film backwards and forwards, face upwards. It will be seen that in the process it lops itself alternately in loose folds at "A" and "B" on either side of the dish. If the film is lightly handled and these folds not roughly pulled about, it will be found to take no harm from the seemingly risky performance to which it is thus subjected. The above mode of colouring short title lengths obviates the use of large extra baths. where these are only seldom required. The worker's hands should be protected from dye stains by rubber gloves.

FILM TONING.

This is an entirely different procedure to tinting. Here there is an actual chemical process, involved, inasmuch as toning does not consist in altering the high lights of the positive, but in subjecting

the silver deposit to the action of chemicals which permanently affect its nature, thereby altering its colour. Thus a sepia-toned film will show no remnant of the black deposit it originally possessed. Every tone will here be sepia of varying density, while the high lights will remain practically as they always were—clear white.

Toning baths are used for reasons similar to those governing the employment of tinting solutions, the chief of these being to break the monotony of a constant black and white exhibition. Also, like tinting methods, they must be employed intelligently if sensible results are aimed at which shall help instead of hinder the audience in following the motive of the picture presented. Thus a discerning film producer would not countenance the toning of a snow scene warm russet brown, any more than he would present the happy finale of a drama in such a tone as blue or green.

SEPIA TONING BATH (two Solutions.)

FIRST BATH.

Film **must** be thoroughly washed. Immerse in

Ammonium Bromide	1 lb.
Pot. Ferricyanide	3 lbs.
Water	60 pints.

This bath will keep well and may be used over and over again. Film must remain in it till the silver deposit changes to yellowish white. Then wash for one minute in running water and transfer to

SECOND BATH.

Sodium Sulphide (pure)	$2\frac{1}{2}$ lbs.
Water	60 pints.

Note the above chemical is quite different to the Sodium (or Soda) Sulphite, often previously referred to.

Since the success of sepia toning by this "sulphide" process depends entirely upon the Soda Sulphide being absolutely pure and fresh, this chemical should be purchased direct from some good-class chemical works which is willing to issue it with a guarantee not only of its quality at time of manufacture, but also that the manufacturing date is a recent one. The importance of such double guarantee is in the fact that the chemical not only goes off with keeping, but actually changes to another one which acts as a reducer instead of a toner upon the bleached film.

The effect of a fresh sulphiding bath used after bleaching the film is to turn the deposit in a few seconds to a fine rich sepia, which will at the same time greatly add to the density and contrast of the subject. For this reason sulphide toning is an easy way of correcting under-printing of the positive.

The sulphide bath must be thrown away after each day's work, as it will not keep for long in sufficiently good condition to produce rich, full tones. Its smell is most objectionable, somewhat like that of a rotten egg.

TONING BATH FOR PURPLE BLACK TO RED CHALK TONES.

Copper Sulphate	4 ozs.
Potassium Citrate	3 lbs.
Potassium Ferricyanide	3½ ozs.
Water	60 pints

Dissolve the various ingredients separately and mix.

This copper-toning bath is fairly cheap to make up, keeps a day or two at least, and gives a variety of hues, from purple black to bright chalk red (that is to say reddish brown.) Moreover, since the process is a direct one, the alteration of colour in the film may be watched as it proceeds. Perhaps the best tone of all is that produced after half a minute or less of immersion of the film positive. This imparts to the black deposit a warm purplish tinge that carries with it greatly added density for projection.

Special Warning.—The projection density of toned film is an entirely different thing to that which film so treated presents to the eye. For instance, with both the sulphide and the copper toning processes the appearance of the film on viewing in the hand would never lead one to expect the great intensification of the image which becomes at once apparent on passing it through the projector.

Needless to say, after any process of after-treatment, kinematograph film should be well washed.

BLUE TONES (with intensification of image.)

Ferric Ammonium Citrate	12 ozs.
Potassium Ferricyanide	12 ozs.
Acetic Acid	10 pints
Water	50 pints

Immerse the well washed film till toned, then wash in water till the high lights are clear and free from stain.

BLUE TONES (without intensification of image.)

BATH A.

Potassium Ferricyanide	3 lbs.
Water	60 pints

Immerse film till bleached, then wash very thoroughly in running water (two or three hours) and transfer to

BATH B.

Ferricyanide Chloride	4 lbs.
Water	60 pints.

After five minutes in the above, withdraw the pin frame and plunge straight into a new fixing bath of "hypo," made up plain without metabisulphite and of strength, ten pounds to the sixty pint trough.

The blue colour of the film here completely develops, but may be made stronger by immersion after short washing in a bath of one per cent. Sulphuric Acid, which must be followed by a good final wash.

NOTE.—Strong Sulphuric Acid must be added to water very slowly and with constant stirring, keeping the eyes well back from the mixing receptacle on account of the violence of the reaction which follows. Wherever the worker is unaccustomed to handling strong acids it is better to have these diluted by a fully qualified chemist. Proportionately larger quantities of such weak acid will then have to be allowed in making up all formulae, according to the dilution.

For further directions on the subject of toning positive images, formulae for other colour toners, etc., the reader is referred to the numerous general photographic text books.

TITLING FILM SUBJECTS.

A well-known rough and ready method of film title making is by means of a kinematograph camera supported on a stand so that the lens points vertically downward. Below the lens, near the ground and parallel with it, is a plain dead black surface, (usually black velvet) on which may be placed moveable white metal or cardboard letters. A diagram of the arrangement is given in figure 60.

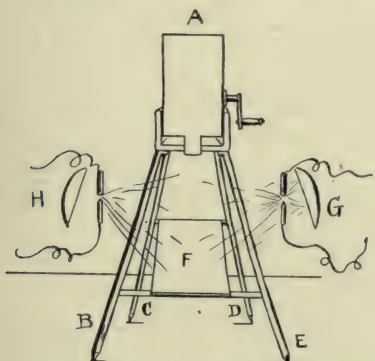


Fig. 60.
Title Making Apparatus.

A, downward pointing camera, B, C, D, E, the four legs of its supporting stand, F, the horizontal dead black surface or "copying table," on which the white enamel letters are arranged and supported while photographing. In the present diagram G and H represent two photographic electric arcs, swung on either side of the copying table F, and of such power as to admit of title negatives being expeditiously made independent of daylight conditions.

In arranging the movable lettering for title making, the greatest care must be expended upon alignment, spacing, and general arrangement of the words, if good class results are to be obtained. Even then the effect got by the use of such rough and ready moveable letters is never up to that achieved when trouble is taken over the preparation of a tastefully decorated black and white title, produced from either a photographic or hand-made negative from the original of an artist properly trained to the work. Such examples of delicate and tasteful design titling, are often to be met with commercially, notably in the case of AB films, and the worst which can be said against them is that the fine line work deals cruelly with inferior focussing

or definition of the projector lens. Where a title is designed on card by the black and white artist it has only to be laid upon the titling table and photographed, just as would have been a type arrangement. Special title printers for use when film making in large quantity are also on the market.

One of the most modern of these is in reality a combination of printer and ordinary still view projection lantern. The original title laid out in white letters on a black velvet ground is first photographed upon a glass plate, by means of a downward pointing still view camera. The black letter photographic title transparency so obtained is then centred before the condenser of a projection lantern contained within the printer cabinet. By means of a suitable objective lens, also within the cabinet and situate between the title transparency and the printer gate, a sharp image of the title wording is thrown upon the threaded positive kinematograph stock. Such a form of photographic printing is technically known as "reduction titling," as in contradistinction to "contact" where the usual kinematograph negative is employed before the positive stock in the printer. With "reduction titling" it will be seen that only the single thickness of unprinted positive stock is threaded in the gate, the place of the negative film being

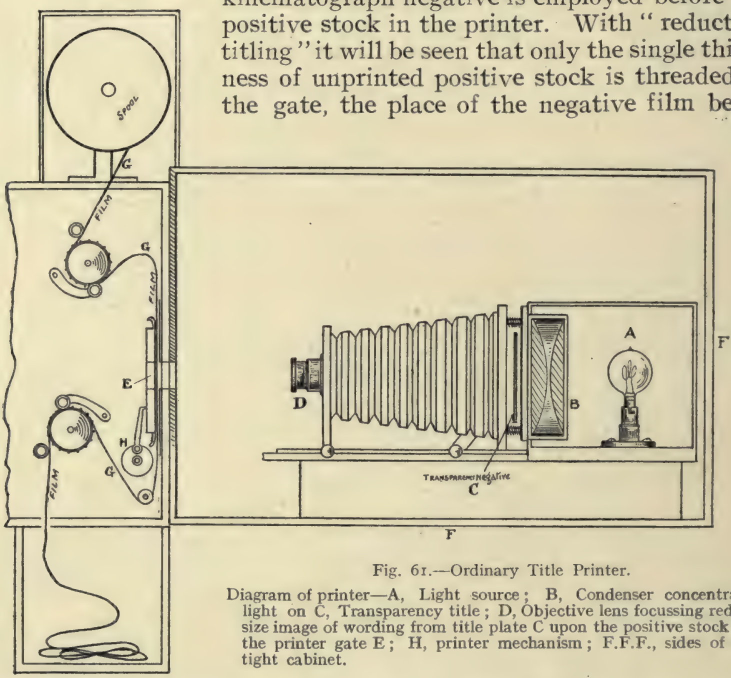


Fig. 61.—Ordinary Title Printer.

Diagram of printer—A, Light source; B, Condenser concentrating light on C, Transparency title; D, Objective lens focussing reduced size image of wording from title plate C upon the positive stock G in the printer gate E; H, printer mechanism; F.F.F., sides of light tight cabinet.

taken by the projected image of the title borne upon the transparency in the focus of the interior projection unit. The system gives white or black letter titles, according as to the original lettering photographed.

Perhaps this is the place to take note of the reason why titles are usually done in white instead of black lettering. If black letters

were used upon a dead white ground the flood of light on the kinematograph screen when the title came to be projected would blind the eyes to the duller picture representations which followed. Hence, wherever black letters are made use of, care is taken to tint the surrounding film deeply enough to take off the glare. With white lettering, however, provided the lines are kept somewhat thin, there is not enough of the screen illuminated to tax the eyes unduly, while at the same time the letters stand out doubly clear and readable on account of the surrounding blackness of the sheet.

In exposing and developing title lengths great care must be exercised so as to ensure good contrast in both negatives and positives. Under or over exposure must not be tolerated, and if artificial light be employed from a constant source, at a constant distance, nothing but the most supreme ineptitude on the part of the title maker can possibly bring about such a mistake as wrong exposure after once the correct time has been ascertained. For the making of clear black and white titles, moreover, it is imperative that thickly coated film stock be employed. This is one of the rare cases where positive stock and the positive developing bath may usefully be pressed into the service of negative making as well as for the actual title printing.

Titling in a Hurry.

The following process is suitable where only a few copies of a given title are required at once. In this case spread white paper on the copying table and arrange black lettering upon it to form the required words. Photograph direct upon positive film, but have it threaded into the camera **wrong way round**; that is celluloid side to the lens. The result of developing a film length so exposed will be the production of a correct white letter title reading right way round and produced at one operation. But since the first film has given us a positive right away, there will be no negative available for producing title prints.

Titling for the Occasional Worker.

As before, we give brief instructions for the small man. Get a local letterpress printer to print the title required neatly in the ordinary black letters upon white card. Pin this card up, and photograph upon positive stock threaded in the camera wrong way round. The result will be a correct white letter title at the one operation just as in the last case. But the method of getting the original printed in ordinary letterpress type obviates the use of a regular titling arrangement, such as figure 61. Where only the one title is required with any given wording, the cost of production is cut down fifty per cent. through doing without the exposure of an intermediate negative length.

Whether white or black letter titles are produced, they should be well tinted in a suitable tinting bath, save only such title designs as have been artistically executed with very fine white line lettering. These are best left plain.

CHAPTER X.

THE AFTER TREATMENT OF NEGATIVES AND POSITIVES.

Let it be explained at the start that much of the after treatment about to be discussed in the present chapter is not by the nature of things either necessary or even applicable to perfect negatives, prints, or conditions of production. After treatment is, in fact, for the most part nothing more than cobbling up inferior goods so as to make them passable for the market. An exception must be made in the case of the special after treatment adapted to the purpose of hastening the production of topicals.

After treatment of the cobbling variety is called for in the following circumstances: either the film is too thin or too dense. To be accurate, each of these classes should be sub-divided; thus of thin films there may be—

(*a*) Thin films which are also flat (wanting in such tone differentiation as might reasonably be expected after due allowance for general want of density). Such specimens are the result of under-development, coupled with more or less over exposure.

(*b*) Thin films in which shadow detail is more or less lacking, or only very faintly visible. These are the result of scanty exposure, coupled with under-development.

The two classes of over-dense films are

(*c*) Over-dense flat-looking films, the result of over-exposure and over-development.

(*d*) The well-known strong soot and whitewash effect, which always goes with bad under-exposure and forced development.

Before dealing with failures belonging to the other three classes let us say at the start that class D is always pretty hopeless. Sometimes a soot and whitewash negative or print can be bettered by careful reduction in a bath of five or six per cent. Ammonium Persulphate until the over-dense parts of the deposit have been pulled down sufficiently, when further action is stopped by plunging without rinsing into ten per cent. Soda Sulphite solution. The treatment is however erratic and generally disappointing. When applied to the positive it is apt to spoil its tone, and when applied to the negative it usually spoils that too. On the whole, therefore, it is as well, except in exceptional cases of the kill or cure variety, to regard bad soot and whitewash negatives as past praying for. The other three states of negative imperfection are, however, often quite remediable.

For instance, take the case of films belonging to class A. The treatment here is immersion in Howard Farmer's reducer (for formula see later in the chapter) till the thinnest shadows become, apparently, clear gelatine. Of course, it will have been understood that the term "thin film" as used a little while ago, applies to the appearance of the silver deposit of the image and not to any mechanical measurement of the thickness of the celluloid base. Well then, when the thinnest parts of the deposit on this originally thin film have been reduced by the reducer to almost vanishing point the film is well washed. Next, the wound frame bearing it is immersed in one of the two intensifiers of which the formulae are also about to be given. Either intensifying bath will serve, though the mecuric iodide one usually gives far more strikingly satisfactory results. The treatment sketched out will be found to have the effect of making the heavier deposits of an A type film rather more dense than before, while at the same time taking the flatness out of the lighter portions representing shadows. The Copper Bromide intensifying bath to be found in chapter 3, part III., is excellent for treatment of films belonging to this (a) class.

B CLASS FILM FAILURES. This is the class which shows striking improvement by after treatment. Where the failure is the simple result of under development or under development coupled with not too great under exposure, the mercuric iodide intensifier will work something approaching a miracle. This may well be taken note of by any film house engaged in topical production, and which may not already be aware of the effect of such intensification. Often and often the iodide bath will be found the means of turning poor almost unprintable topical negatives into respectable ones. Positives may also be intensified in the same way, though this course is not recommended where not absolutely necessary, since purity of tone and transparency are sure to be more or less impaired by such after treatment of positive films.

C CLASS FILMS are treated simply and solely in the Howard Farmer reducer. The process of reduction must be watched carefully and stopped when gone far enough by transferring the frame carrying the film from the reducing bath to the washing trough.

HOWARD FERMER'S REDUCER.

Water	60 pints
"Hypo"	8 lbs.
Potassium Ferricyanide	4 to 16 ozs.

Directions :—Dissolve the "hypo" in a few pints of warm water, make up the bath to volume, adjust temperature as near as possible to 70F, and last of all stir in the Pot. Ferricyanide (syn. Red Prussiate of Potash) dissolved in a pint or so of water. Then at once plunge in the film to be reduced. The bath keeps very badly, losing all its reducing power within an hour or so of making up. It is at its best for only about ten minutes. The more Pot. Ferricyanide is added the quicker will the reducer work. In cases where it is only required

to remove a slight veil from positive or negative film, use a bath containing only 2 ozs. of Red Prussiate instead of the larger amount set down. After the bath slows down it may be revived once or twice, by addition of Red Prussiate, but in any case must soon be thrown away and a new one compounded.

MERCURIC IODIDE INTENSIFIER.

Soda Sulphite	8 lbs.
Mercuric Iodide	6 ozs.
Water	60 pints

DIRECTIONS :—To make the bath, first dissolve the Soda Sulphite in 20 pints of warm water, cool, and stir in the bright vermilion coloured Mercuric Iodide Powder till all has gone to form a colourless solution. Lastly make up the bath to 60 pints by the addition of a further 40 pints of water. This intensifier will keep fairly well in the dark, but goes off quickly in daylight, depositing the mercury as a black powder at the bottom of the trough.

A way of making it up quickly and without the possible delay entailed in procuring the rather out-of-the-way salt—Mercuric Iodide —is the following :—

FIRST SOLUTION.

Dissolve three and a quarter ounces of Mercuric Chloride in four or five pints of hot water, and pour in immediately (with stirring) a solution composed of four ounces of Potassium Iodide, dissolved in a pint of warm water. The effect of making the above mixture will be to throw out a copious precipitate or deposit of the vermilion coloured Mercuric Iodide, which, after well stirring, and subsequent standing for a little while in the quiet, will fall down as a sediment at the bottom of the receptacle. When this happens the clear liquid above is gently tipped off and thrown away. Finally, the red mushy precipitate remaining is stirred into soda sulphite solution precisely as with the dry mercuric iodide in the preceding formula. The quantity of the red salt formed by working to the proportions just given is also as near as possible the six ounces previously stipulated, so that there is no need to dry and weigh it before dissolving. To make the effects of this bath permanent, the intensified film should be washed ten minutes after removal, then plunged for ten minutes into strong developer, and again well washed. Never place film in a fixing bath after any form of after treatment, unless this is definitely recommended.

CHROMIUM INTENSIFIER.

Unlike the baths given up to now this intensifier works in two stages. Accordingly two troughs are necessary to hold the solutions that compose it.

BATH I.

Bichromate of Potash	1 lb.
Strong Hydrochloric Acid	6 ozs.
Water	60 pints

Crush the bichromate, dissolve in five pints of hot water, make up total contents of the bath by addition of cold water to the sixty pints, and finally stir in the Hydrochloric Acid. Well mix.

BATH II.

Any ordinary strong developer. Double strength Metol Hydroquinone without bromide answers well.

METHOD OF USING CHRONIUM INTENSIFIER.—First immerse film in Bath I. till the black silver deposit has turned to a dull lightish brown. Wash in washing trough till the yellow bichromate stain is totally removed from the clear parts of the film (this may take two or three hours) and lastly plunge into Bath II., till blackening of the image has taken place.

Comparing the characteristics of the two intensifiers above given the following may be noted :—

MERCURIC IODIDE INTENSIFIER.

The outstanding feature of this is that it intensifies the lightest deposits strongly, as well as the darker ones. Thus it is especially suitable for the improvement of film in which under-exposure goes with under-development, as in the case of many topicals. Also the bath allows of intensification being directly watched during continuance of the process.

The Mercuric Iodide bath is rather expensive to make up, and though it may keep fairly well this is not always the case.

CHROMIUM INTENSIFIER.

This intensifier is exceptionally cheap to compound, and Bath I. keeps for a long time in a stoneware trough. Bath II., being practically speaking an ordinary developer, is usually on hand without the necessity for making it specially.

The Chromium Intensifier differs in characteristics from the Iodide Bath chiefly in that while it intensifies medium and strong densities still more strongly it is apt to neglect the very lightest deposits. It should, therefore, be of especial service in correcting flatness of image due to over-exposure and under-development though the writer cannot say he has always found this so in practice. Certainly it is not so good for topicals, etc. Intensification takes place in two stages with the chromium intensifier, going to bring about one set increase of density each time the film is treated successively

with Baths I and II. Moreover, since the result is not capable of being judged by inspection before the end of the whole double process, the amount of intensification with the chromium method cannot be said to be as completely under control as when employing mercuric iodide.

Where one treatment with the chromium intensifier does not prove sufficient, the process may be gone through a second, or even a third time for greater density. No long washing is necessary between removal of a film from the fixing bath and commencing chromium intensification.

Special After Treatment for Time Saving.

The above is called for almost solely when dealing with topical work. The problem here is generally that of cutting down the washing and drying times as far as possible consistently with safety to the film. This may be done to a large extent by use of the two following baths :—

"HYPO" ELIMINATING BATH.

Peroxide of Hydrogen	½ pint
Water	60 pints

Film is taken straight from the fixing tank, rinsed for one minute with constant agitation in the washing trough, then transferred for two minutes to a trough containing the above solution, which has the power of destroying and rendering harmless to the film the remainder of the "hypo," with which it is impregnated. During the time treatment with the peroxide is going on see to it that the water of the washing trough is completely changed. At the expiration of the two minutes a further couple of minutes' washing in running water is given (washing in the trough with syphon going and water supply on to the full.) We may now safely transfer to a bath, composed as follows :—

HARDENING BATH.

Formalin	3 pints
Water	60 pints

After ten minutes' immersion in the formalin trough, kinematograph film becomes sufficiently tough to be dried by moderate heat without injury to the emulsion. A device for such forced drying will be found in the next chapter.

With regard to the keeping properties of the two last baths, the peroxide one may be used several times before it is exhausted, while the formalin will serve for weeks or perhaps even months on end, depending on the freedom or otherwise from chemical impregnation of the film immersed in it.

NOTE.—Wherever time is not of paramount importance kinematograph film, both negative and positive, should be allowed to dry spontaneously and without hardening. Hardened and heat dried film always has a more horny and less pliable and satisfactory surface than the normally produced article.

For further note on intensification, see appendix to this part.

CHAPTER XI.

DRYING.

Drying is the final operation in the routine part of film production and, perhaps, from every point of view, it is as well.

In its simplest and best form, the drying of kinematograph film, whether negative or positive, is accomplished by winding it upon a wooden skeleton drum, and leaving it to do the rest for itself. Where only small quantities of film are in question it will be found sufficient for our purpose to make use of a correspondingly small drying drum such as may easily be constructed by any journeyman carpenter, or even one who is not a carpenter at all. Moreover, an occasional turn of such a drum by hand will be all that is necessary to cause the water to dry off the film equally. Figure 62 gives the idea of an efficient small-sized drum, such as comes in handy for the spontaneous drying of film lengths up to 200 feet or so. The ends, composed of thick wooden circular plates three feet in diameter, are firmly threaded on a stout metal axle, A A, composed of thick iron pipe. Between these ends of the drum thin, springy, wooden slats or lathes B, B, B, etc., are nailed or screwed. The lathes are the supports on which film is wound for drying, and care must be taken that they are springy enough to allow of a considerable amount of film shrinkage during this process, which shrinkage is the counterpart of the film expansion that occurs on wetting, as already noted in the chapter on negative development. A suitable support upon which the drum may be rotated completes the whole simple arrangement. All that is necessary when using such an elementary piece of apparatus is to take care that the film is wound on to the cross lathes in a regular and fairly close spiral, that it is not stretched over tight, and that the beginning and end of the wound length come sufficiently far from the drum ends to allow of the natural springiness of the slats coming into play upon every portion of the drying film. The two film ends are fastened by means of drawing pins. An occasional turn of the drum by means of the hand after winding, say once every two or three hours, will help in getting rid of collected water drops, and is all that is required to cause nature to do the rest of the drying process. Fig. 63 shows a handy little attachment for use with such a small-sized drying drum, and

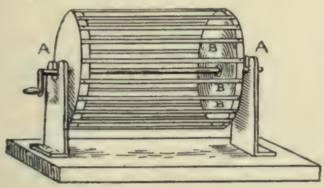


Fig. 62.

which admits of the accommodation of longer lengths of film by allowing for contraction right to the drum ends themselves. As will be seen, the attachment consists of nothing but a short elastic loop, " A " having a small wooden block " C " swung at one end of it to which block the film may be pinned, while a second drawing pin " B " at the other end of the elastic loop allows of its being attached to either end of the drum, and in any desired position along its rim. Obviously the virtue of such an arrangement is that the elastic provides the necessary compensation for whatever film contraction takes place, thus obviating any bursting of the half dry film end from its moorings, which would certainly sound the knell of part or all the film length.

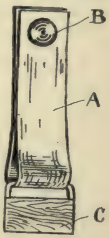


FIG. 63.

Let us now pass to the drying drum as usually constructed on a fairly large scale. Here the only great departure from the arrangement shown in figure 62 is in the matter of the film supporting lathes. Instead of being made springy to allow of film contraction, the necessary compensation is here obtained by means more consistent with the unavoidable extra solidity of the whole construction. A way of obtaining perfect stability of the drum's structure while still allowing for film shrinkage is by means of the system of hinged film supports as depicted in figure 64. The small diagram (A) shows the actual method of hingeing the slats, while the larger one (B) represents them in operation upon part of the surface of a drying drum. In B, A represents the film as wound upon the hinged slats C, C, C, C, and before drying has commenced. It will be seen that the hinges are partly open. As a matter of fact, provided the height and shape of the film supporting lathes has been rightly adjusted, the closing of the hinged slats from their fully open position should be automatic as the film dries. Generally, however, it is advisable to start the hinges as shown in figure 64 B, after winding on the film to be dried. Once this is done the contraction of the celluloid will flatten down the lathes more and more up to the point where drying is complete. In practice it would not be necessary or advisable to hinge all the slats on a drying drum of this variety. One hinged one, and then two or three firmly supported ones is a better proportion. Also where film drying is being carried on upon a large scale common sense will suggest that it is more economical in the end to pay the salary of a competent drying room attendant who will be on hand all the while and keep constant or frequent supervision over the tension of the film upon

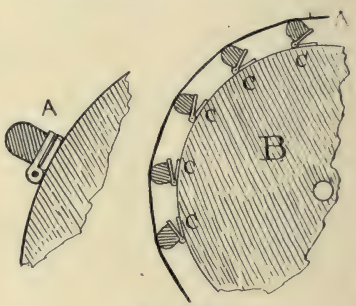


FIG. 64.

the drum, rather than chance the spoiling of large batches of film by breakage when no one is about to set matters right.

Returning once again to the general design of the drum in fig. 62, it will be easy to see that for film drying on a large scale, constant rotation, by means of a pulley wheel attached to the spindle "A," presents no element of difficulty if power is available for the purpose. Also some experienced workers hasten drying by turning the hollow centre shaft into a species of bunsen burner, which alteration can be simply done if the necessary mixture of gas and air be conducted in and holes bored in the length of the pipe within the wheel to serve as bunsen jets. The drum in this case would revolve free, while the

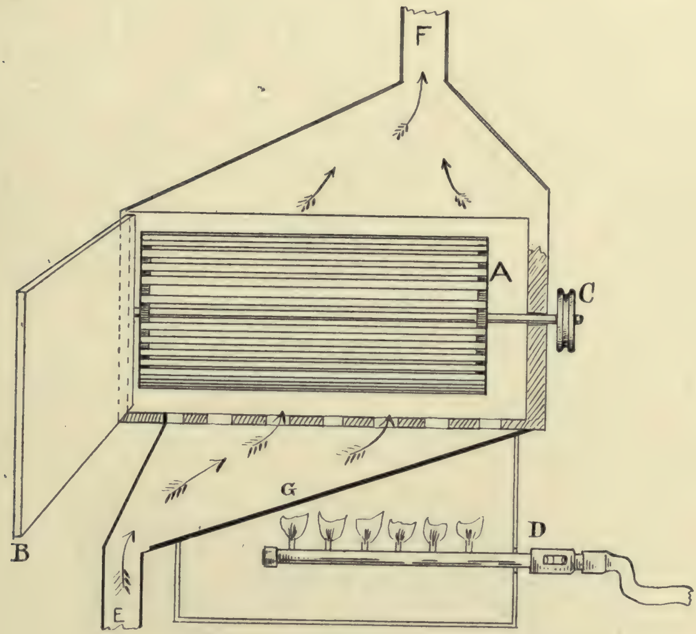


FIG. 65.

axle would be fixed. At the same time the process of drying film with the aid of a wheel having internal flame, though rapid, is risky. It is better to stick to a well-warmed and well ventilated drying room with plenty of gentle heating, by means of hot water pipes, and let this suffice for all ordinary purposes. For topical work only is faster drying imperative or even desirable. Then we had best have recourse to some form of enclosed drying wheel, such as is figured in figure 65. The arrangement here sketched will be found susceptible of being constructed as a small partitioned off compartment in the regular drying room, or it may be substantially built to any size

necessary to cope with the firm's output. Moreover, there is really no limit to the heat which may thus be fed to the film, for which reason only formalin or quinone hardened film (see appendix for the latter) should ever be subjected to such a forced drying system. In any case see to it that a trustworthy thermometer is so embedded in the wall of the drying compartment that the temperature of the inside may be seen from outside at a glance, and do not let this temperature rise above 90 or 95 F., as no wet film, even though hardened, could be expected to stand higher temperatures. The above heat, combined with brisk rotation, should be enough to accomplish the drying of film in not more than three quarters of an hour. For the sake of simplicity in drawing the arrangement for drying by heat is represented as a cupboard. "A" is the drying drum, suitably pivoted, and which may be rotated by power communicated through the belt pulley "C," situated outside the drying compartment. Following out the cupboard idea, "B" represents the door shown open, but which is capable of being closed so accurately as to all intents and purposes to be air tight. "D" is a row of bunsen burners, enclosed in a metal casing, and the function of which is to heat up the under surface of the hot, plate "G," comprising the under side of the air inlet "E." Hot air will accordingly pass up from here through the grating under the drying drum, and over the surface of the wound and rotating film, till it finds its way out by the upper air outlet "F."

Such an arrangement is simply installed, and will be found thoroughly efficient for drying topicals. Where expense is no object a system of hot water pipes immediately surrounding the drying drum, and radiating heat from water at a known temperature, may be substituted for the gas heated hot plate, and either method may be relied upon to give satisfactory results from the topical point of view with hardened film.

FIG. 66.—ONE OF THE PRINTING ROOMS AT THE HEPWORTH WORKS.

CHAPTER XII.

TRICK KINEMATOGRAPHY.

Hitherto we have confined ourselves to the consideration of ways of photographing actually proceeding actions. With trick kinematography, however, an entirely new element is introduced into the work of the picture maker, for by its means it is not only possible but often easy to turn out film subjects representing actions and situations which never could have arisen in real life.

Let us try to enumerate some of the various devices made use of in obtaining trick effects.

Miraculous Appearances and Disappearances.

These are amongst the easiest of trick effects to produce. Indeed they are supposed to have had their inception through a pure accident which came about in the following way:—

A well-known kinematographer (quite in the early days of the industry) had taken a film exhibiting the departure of a train from a railway station. One of the last people to enter it before it steamed off was a certain young man known to the photographer. This passenger hurried up, newspaper in hand, and made a run for a near by compartment just as the whistle of the engine was going.

Now it so happened that some months later the maker of the film happened to see an old copy put on in a touring kinematograph show. Naturally he looked out for his friend to come on the film and make the wild dash for the carriage during which he had been photographed, and in due time the young fellow with the newspaper appeared, ran half way to the compartment door at which he should have entered, and———of a sudden he was no more. He had vanished. Of course, the reason was easy to divine. The positive film had got worn and had broken at the point where the incident should have culminated, the result being that a foot or more of it had been cut away by a none too careful film mender. But the sudden disappearance of the traveller was destined to be the starting point of many another deliberately produced effect of the same kind.

The motion picture producer hurried home and set himself straight off upon the production of a ghost film, in which the whole effect was obtained by cutting out portions representing the moment of appearance and disappearance of each white clad sepulchral figure, the result being that these ghosts came and vanished on the screen in the same sudden and unaccountable manner. Such, at any rate,

is the story of the manner of the inception of appearance and disappearance effects as told to the writer by one whose word he has no cause whatever to doubt.

According to modern methods, where it is desired to bring about a miraculous disappearance one goes to work much in the same way. There is, however, no need to waste film in cutting when photographing such trick effects, since the same result is better obtained by the simple device of stopping the camera handle during the ghostly entrances and exits.

Let us take a case in point and examine how such a magical appearance or disappearance can be made use of, and how its accomplishment is set about in practice. Take the well-known Pathe film "The Enchanted Glasses." A part of it represents a young woman

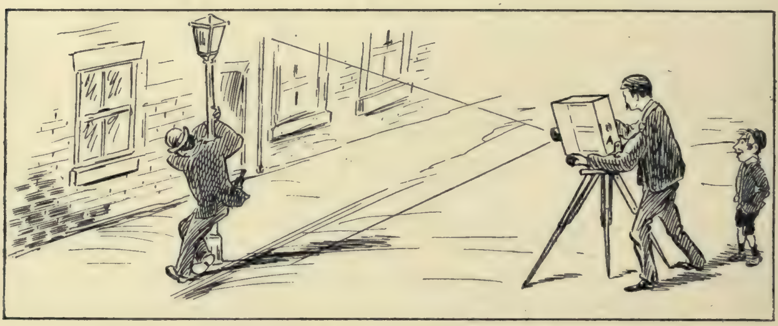


Fig. 67. — A simple trick effect. The gentleman clinging to the lamp post is acting as though intoxicated. Still further to heighten this effect, the camera man, while taking the motion picture, rocks the tripod top by means of a suitable screw action with which it is provided. The result is to give a picture which sways on the screen as projected. This effect can be obtained with an ordinary 'maxim' tripod head by screwing on the camera at right angles to its usual position.

flourishing a piece of cloth in front of a dark curtain. Suddenly, as she twirls the cloth about, another girl appears behind it as though from nowhere.

To photograph such an effect the camera handle is stopped abruptly when the cloth is in the act of being waved about in front of nothingness. While now the camera is out of action the girl who is to "appear" steps into position for her "appearance." The waving of the cloth is recommenced, the camera handle is once more smartly started, and the resulting film negative will show two adjacent pitcures, in the first of which the magically produced young lady is not visible, while in the next she is. On putting through the projector the positive printed from such a negative the effect will show the seeming production of a girl from nowhere. For a marvellous disappearance the above course of events is merely reversed.

Magical Metamorphoses.

As an instance of this sort of trick work may be cited the film "Lord Feathertop." Here a beautiful young lady is in the act of being married to a very fine young fellow, when the latter changes in a flash to a giant-sized dutch doll. The effect is really the combination of one of the already described "disappearance" effects with an "appearance." The young fellow taking the part of the bridegroom steps out of the picture, and the monster dutch doll is placed in position during the one interval in which the camera turning has been stopped.

Fatal and Comic Accidents.

Although neither of these usually figure before the public as trick

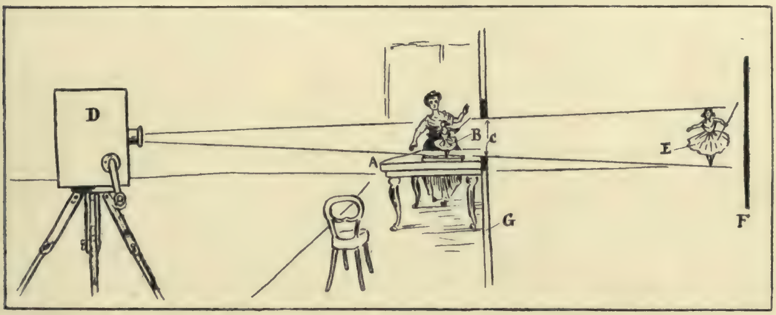


Fig. 68.—The dancing midget. This effect depends simply upon an observer's comparative inability to perceive distance except by relation to intermediate objects. The camera D is set to photograph the table A, which stands before the partition G. In this partition is cut an aperture C, behind which and at a suitably great distance, is the living model E. The background F is of the same tint as G, so that the want of continuity is not easily apparent. When carefully planned out, the effect may be as though a figure much smaller than life-size was situate at B. The lens of the camera must be greatly stopped down.

effects they would both be out of the question save for the technique of the magical metamorphosis given above. The fatal accident occurs more and more often in modern dramatic films. Perhaps it is a distracted young girl who determines to throw herself out of a top floor window, and does so. At least the audience sees her climb to the window ledge, give a last convulsive shudder, and pitch forward and down past storey after storey, until the body flashes out of view at the bottom edge of the picture mask. Or, again, it may be a comic accident, such as the submerging of a couple of tramps by a cartload of shingle, which submersion would hardly have been good for the actors taking the parts in question had they really remained to bear the brunt of the accident. Sometimes even a steam roller is requisitioned to go right over a man in a comedy film, in which case he invariably gets up again and resumes normal activity in a surprisingly

short time. Small wonder if the audience marvel how it's done. The above instances and all of a similar sort are worked on the principle already alluded to, a metamorphosis being effected in each case between the living subject and a more or less life-like dummy.

Thus the suicide girl is only a flesh and blood creation up to the moment when she gives her last convulsive shudder on the window ledge. From that instant she retires from the stage (the camera handle being conveniently stilled to allow of her doing so.) When it restarts its record making revolutions it is a dummy which goes pitching down to its death somewhere beneath the picture mask.

The comedy man who lies down in the track of the steam-roller takes good care not to remain there so long as he seems to do. It is a dummy which is gone over and duly flattened, while a second

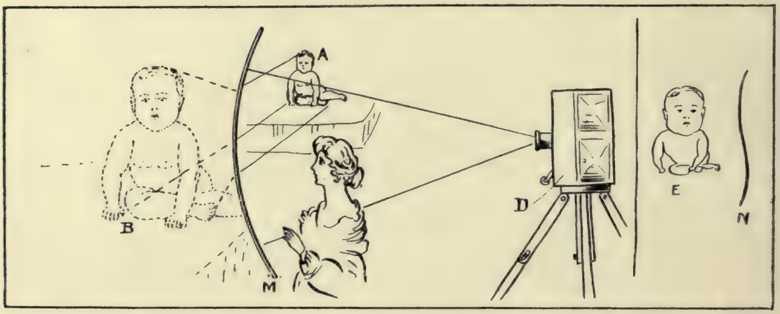


Fig. 69. — This shows how a giant baby may be taken by reflection from a real one. The original subject A is reflected in the concave mirror M, and it is this reflection which is photographed. The presence of the mirror need not be apparent in the result. N shows an undulating mirror by means of which a still further distorted rendering of the baby would be given ; this time with big head and tiny legs, as depicted in E.

convenient pause in taking, allows of the effigy being hastily removed for the real man to resume his place in the track of the steam-roller as it once more passes on its way.

Ghost Effects.

Here is another class of effect which, though usually realised by the audience as of the trick variety, has, nonetheless, its place in many an otherwise "straight" dramatic film. Although ghost films of a sort may be produced by no more elaborate method than that of the trick appearance and disappearance, explained at the commencement of the chapter, yet the modern mode of going to work is very different and much more elaborate. For instance, we may see the signalman sitting in his cabin contemplating the result of a mistake he knows himself to have made in the setting of the

points. In the semi-darkness and silence there flash upon his mind thoughts of the train wreck and consequent loss of life he believes to be inevitable. Suddenly as he sits horror-bound the thoughts take tangible form before the audience. Thin white hands appear from the darkest corner of the signal cabin and growing momentarily in substance seem to reach out and demand vengeance for the wretched man's fatal mistake. Little by little the ghosts of the killed passengers take shape till they come clamouring one after another nearer and yet nearer to the object of their hatred. And all the while the signalman sits glaring wildly at the phantoms in a frenzy of dread. How is it done? There are no tame ghosts, even in the most up-to-date film producing studios.

The secret of it lies in two things. One of them is a special dead black floor covering and heavy black velvet background, which are always kept handy wherever ghost production is a feature. The other secret lies in the correct use of the feet film indicator to be found affixed at the side of every good class kinematograph camera of recent design. Background and indicator are worked together in the following way. Firstly the subject who has to be ghost haunted goes through his part before an ordinary background and is duly photographed, the only odd thing about it being that though when the critical moment arrives he makes every indication of having seen whatever spooks are to be in evidence, he really sees none whatever, because they are not there to see. No matter. When he has to be scared, he makes sure his hair curls and his face gets contorted with horror enough for the occasion. Meanwhile an assistant standing by the camera man is diligently reading the camera feet indicator. His business is to register accurately the number of feet exposed both just before and just after the supposed spook invasion. When this "straight" part of the scene is concluded, the exposed film is wound back again from the take up to the top film box, by means of a special device fitted to cameras used for this work, and indeed to all instruments of the "reversing" order. Now for the black background and the spirit manifestations. Once again we wind forward our film, without exposure, up to the point where the feet indicator tells us the ghost seer is about to be tormented by supernatural manifestations. This time, however, we have the manifestations ready in the shape of suitable actors, draped in white, and posed before the special velvet curtain, with full instructions as to their actions, etc.

Now to turn the camera handle once more, while the assistant gradually opens the lens iris from its smallest to a suitable working aperture. The result will be to impress upon the already once exposed roll of film a second record of the white draped figures, which record grows in intensity as the stop aperture gets larger in the camera lens. When the film indicator indicates the point at which the ghosts must disappear, the diaphragm is first turned down to its smallest and the camera handle then stopped. Result: filmy white

spooks, which grow in body, fade once more, and disappear. As such, at any rate will the audience see them when the print from the negative comes to be put on the screen.

In working effects of this kind one should see to it that the part of the "straight" background against which the spirit manifestations have to be made is suitably dark in tone. Also such effects to be worth seeing must be very carefully rehearsed and arranged. For timing them the film indicator checked off by a smart assistant, is the one and only reliable guide.

Reversing Effects.

Although the more blatant reversing effects are now to a great extent out of date, trick work of this kind is still sometimes seen.

In essence the reversed effect is the result of turning the camera upside down at the time of taking. When this is done it will be found the positive subjects may still be threaded through the projector so as to give an image right way up as usual. Only now the action of the subject on projection will proceed in the contrary direction to that ordained by Nature. For instance, suppose in the subject photographed with reversed camera a tea tray, full of china, has been allowed to fall and the china smashed. The projected incident will show the start of the film with the broken tea service lying upon the ground. Suddenly the pieces will be seen to spring together, the whole will be met by the tea tray, which will trundle up from whatever may have been its final resting place, the ware will set itself magically upon the tray, and the latter, now fully loaded, will spring up into the outstretched hands of the one who was destined to be carrying it at the time of the accident. The end of the film would, in fact, depict the beginning of the scene.

In practice, this extraordinary reversed movement has been applied to a host of weird situations. One of Pathe's earlier films: "Quick, I'm on fire!" was almost wholly dependent upon reversal for its drawing quality. It was a film of the "chase" variety illustrating a man who had been set on fire in the seat of his trousers running madly on and on in the effort to put the fire out. Every now and then he would spring up to a house top or slide up a sloping board at the speed of an express train, or roll hard up hill, always followed by the usual yelling crowd which imitated his strange gymnastics. In the end he is seen to emerge from a river by a reversed high dive, coming out of course still alight.

Recent cameras, intended more especially for trick work, are fitted, in addition to the ordinary take up, with re-wind or take up arrangements to the top spool box, which second set can be put in or out of operation as required, and alternatively to the ordinary one. Such cameras have also a special driving shaft, which turns the intermittent motion the reverse way without having to reverse the turning

direction of the handle. With such a system no inversion of the taking camera is necessary. The above, together with the addition of a film indicator, renders the instrument useful as well for ghost effects and many other purposes away from the usual run of everyday work. Part of the "Enchanted Glasses" film, already alluded to, where the wine pours upwards from the glasses and back into the decanter is a good instance of effective yet not obvious reversal.

AERIAL EFFECTS. AIRSHIPS, BALLOONS.

The above class of trick effects seem to be worked rather extensively at present. Probably the aviation craze is at the root of it, though the same system which reveals to the watcher of the

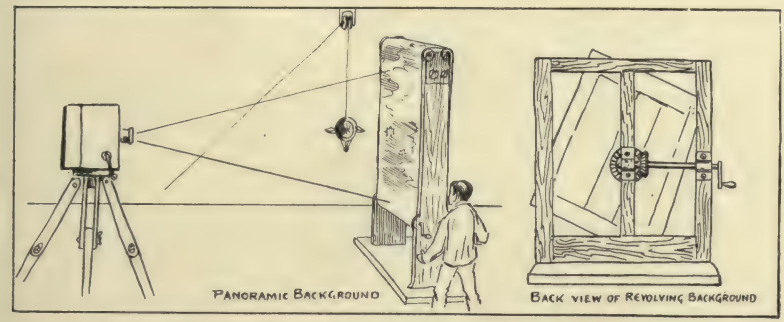


Fig. 70. — This illustration gives the method of obtaining airship effects by means of trick kinematography, as explained in the text. The toy airship is suspended by fine thread from a suitable overhead travelling trolley, while the background, representing sky, can be wound up or down by the assistant, as depicted. The other background support (shown in back view) is fitted with a rocking device for use when photographing earthquakes, rough seas, and such like effects in trick work.

kinematograph sheet the "heights of the air" may also serve equally well to set forth a more or less garbled version of the supposed depths of the ocean. To be specific, let us confine our remarks here to the type of effect where the picture projected before us shows a glimpse of a balloon or airship moving upwards through the clouds, till suddenly it explodes and falls headlong earthward. As we watch we see the rolling vapour before and behind the balloon basket. Probably the cloud effect will not be entirely convincing, yet the very ability to depict a balloon soaring up and up through any sort of clouds strikes wonder into our hearts until we know how the photographer set about it.

As a matter of fact the above class of thing is done with the help of models combined with the more or less skilful use of what is known as an ascending and descending background. For the latter

two round rollers are arranged on a suitable frame, and canvas stretched between them and so that it can be wound from one to the other after the manner of a child's myriorama. Suppose one of the rollers situate at such a height as to be well above the picture while the lower roller is equally below the bottom of the picture. Our whole picture then depicts "sky." If we paint clouds upon the canvas we have only to wind slowly upon the lower roller to give the idea of ascending to anything in the way of a model aeroplane hung before the "sky," while a sharp turn of the higher roller will impart to the model the idea of dropping, since the clouds will appear suddenly to run upwards.

As to the model balloon itself, it is a tiny affair cut out of suitably painted paper, or if it is to appear on a larger scale it may be an ordinary toy one. When photographing the balloon ascent all we need to do is to get one assistant to introduce the model before the camera lens on the end of a bit of fine silk, as though it were travelling along in space, while other assistants make the clouds descend slowly and regularly. Mist effects are imparted by the usual thickness or thicknesses of gauze allowed to drop down between the model and camera. An aerial explosion is easily worked with the help of a suitably contrived smoke puff, following which the cloud rollers are reversed, while a delapidated balloon "double" is rapidly lowered down through the picture and out of sight.

A great number of such kinds of subjects are worked by means of models and panorama backgrounds of this sort, while in other cases larger panoramic backgrounds, either ascending, descending, or moving from side to side are employed with living subjects to impart to the latter the illusion of unnaturally quick or eccentric movement.

Tom Thumb in his seven league boots is an instance in which a laterally moving background was effectively combined by two separate printings (see later) with the subject of a boy performing the action of running seemingly in mid-air. The well known, not to say classic film, "A trip to the Moon," also made use of the descending background, though here still another principle was involved, which latter should be dealt with by itself.

The Downward Pointing Camera.

For a diagrammatic arrangement of such a camera reference should be made to the chapter on title production. The principle there set forth of pointing the camera vertically downward is one which can be easily applied to trick work on a large scale. Where necessary the camera can be placed up in the roof of a lofty studio so that people can be taken full size while lying down, etc. Obviously with such an arrangement the camera lens will have the same relative position to the prostrate model as would the lens of a normally supported picture camera to an upright model. It will therefore be possible to obtain many seemingly baffling travesties of the action of gravity by means of the downward pointing motion picture camera arrangement.

As has already been hinted "A Trip to the Moon" remains probably the most classic of all films which go to exemplify how the vertically pointed lens may be used in trick work.

In this film an elderly gentleman was depicted as climbing up into the night sky, past the stars, and right on to the moon's disc itself. The moon then opened its mouth (if memory serves) and swallowed the traveller.

It was all contrived by means of a descending background worked in this case flat on the studio floor, while the taking camera was perched up above, looking downward. The man who had to make the journey to the moon in reality crawled slowly along the star painted canvas as the latter was wound from roller to roller. Finally the moon's disc was wound into position to occupy the centre of the kinematograph picture in process of being taken. Thereupon the gentleman taking the "trip" crawled through the slit of the moon's mouth which had been made practicable for the purpose.

A far different and yet equally amazing effect of the downward pointing camera is the self-forming title which used to be so much in evidence a few years ago. In reality it was formed by the gradual displacement of the letters of the title during the time they were being photographed by means of the downward pointing motion picture camera. For the purpose threads are attached to opposite ends of suitable block letters before laying them out to spell the word or words desired. Fig. 71. The motion picture titling camera is then started, when the letters are moved out of the field with a slow zig-zag motion, imparted by assistants actuating these invisible cords. The letters may be moved in various ways, all at once or one at a time, just as the taste of the one arranging the trick title may incline. Two points, however, are noteworthy in this description. The first is that in the accompanying diagram showing suitable positions for attaching threads to movable letters these threads are shown as black upon a white ground, for the sake of clearness to the reader. In reality, of course, they would be the same colour as the ground, black for white letter titling or white for black letter work.

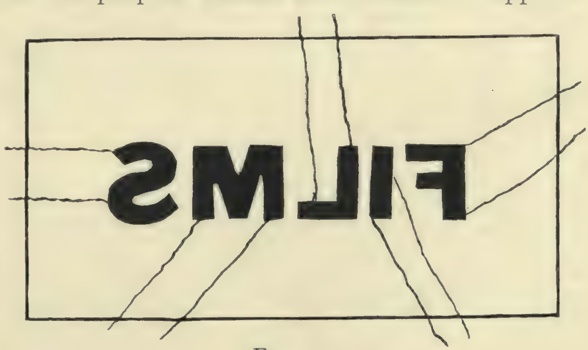


FIG. 71.

The further point to be noted, since it is an essential part of the process, is that when working on the foregoing system, the actual title must be photographed with reversed movement, the *modus*

operandi of which has already been explained in this chapter. Clearly this is necessary, since the effect we want on the screen is that of a title miraculously built up, and not one in the act of being torn apart, as is the case in actuality.

The particularly puzzling and odd step by step effect exhibited by films of the "Affair of Hearts" order, in which purely mechanical arrangement and rearrangement of geometrical areas of black and white follow up each other in a sort of kaleidoscopic sequence, are also produced by means of the vertical camera, combined with infinite pains on the part of the artist operator. By the same means also automatic writing, drawing, etc., of all sorts is produced, the camera being stopped after each picture or two for a few more short strokes to be added or taken away.

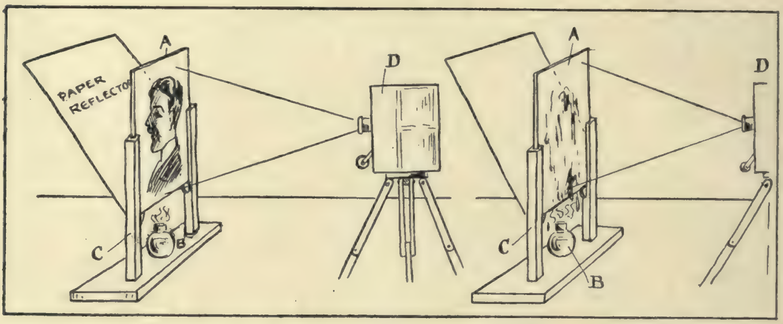


Fig. 72.— A curious reversing effect. A wet photographic transparency plate A on which is a picture, title, or portrait, is stood in a special support C, and photographed with reversed action by means of the kinematograph camera D. Meanwhile the spirit lamp B causes the wet gelatine of the photographic emulsion to melt, so ruining the plate. (See second diagram to note this effect.) The effect on the screen when showing the kinematograph film so taken will be that of a picture, portrait, etc., which gradually forms itself out of nothingness.

NOTE.—Wherever a camera is to be used for trick work it is important to ascertain the exact point nearest to the lowermost phase of each handle turn at which the shutter is at cover position over the lens, since only when turning is stopped exactly at a "cover" point does one avoid the last picture of the series being hopelessly over exposed. Find the "cover point" nearest the lowest position of the handle, mark this position boldly on the camera body, and see to it thereafter that when pausing in trick effect production the handle is brought smartly to the marked point and there stopped dead. Doing this properly will take a little getting into, but the acquirement is well worth the trouble. When turning is resumed this should also be done as smartly as the camera mechanism will stand without undue jar.

Smoke Puffs.

The use of these and similar methods of distracting the attention of the audience at the moment of introducing a trick effect into a film takes much the same place in kinematography as "blacking out" does on the stage. As we know, in "blacking out" the stage lights are turned suddenly down, while a line of brilliant red blinders is flashed in the eyes of the audience in order to distract its attention from some hasty scene re-arrangement in progress behind, and which is not considered to occupy enough time to justify a regular interval being made for it.

Just so with the kinematograph film. Something is to be done and done mysteriously. So instead of merely stopping the camera and re-starting when the rearrangement has been made, the transition may be rendered even more mysterious by a suitable smoke puff thrown out before the lens at the critical moment.

Smoke puffs are of many origins, from the regular smoke rocket to the steam jet or spilt bag of flour. Either will serve for its special use, and which of them is most suitable to any particular subject is a matter best left to the experimental genius of the stage manager.

That smoke and dust thrown into the atmosphere at suitable times and places are true friends of the picture man cannot be denied. With comic work in particular they are in constant use, generally in order to perform the same kindly function as in real trick work—the throwing over a faked incident of the glamour and mystery of detail, which makes it go down as genuine.

Gearing Down the Camera.

Previously we have given advice in the case of all ordinary kinematograph photography to take the pictures at the one constant rate of 16 per second. There is, however, an exception to this in certain trick subjects. Then it may become advisable or necessary to stop down the lens suitably and photograph at a much slower speed than the normal. The film "Something wrong with the time," shows a clock, the hands of which suddenly begin to race round madly while those people within its influence have their movements enormously augmented in rapidity. Undoubtedly much of this film was photographed very slowly, while the ordinary rate of action was maintained by the models taken.

Occasionally one sees a "chase" photographed in this same geared down way. The camera, instead of going full tilt, is worked only at a fraction of its usual pace with the result that chasers appear literally to gallop this way and that over the picture. An ordinary street scene photographed at half speed will show everything going along at double its usual pace, while should the Camera handle be turned much too fast, the relative pace of natural objects will be correspondingly slowed.

Double Printing.

This is the only other phase of trick photography which will be touched upon here. Nor will much be said concerning it, not because it is not a very important branch of trick work, but because it is in itself so complicated as to be more easily approached by the man of experience than by the one newly interested in film production. Still it is possible to sketch out the general method adopted in double printing and this will now be done so far as may be.

A double printed film is one in which two separate and distinct negatives are used over the production of the single final positive. Each negative illustrates a different subject, and each subject is so arranged that it may be printed over the image formed by the other, without effecting an unsuitably jumbled up result. Double printing is being used more and more in modern trick work, but a single instance of its application should serve to show both the principle and broad method of employing it.

Fig. 73.

Let us take for our case in point the production of a "vision" film, in which someone is depicted in a trance or sleep, while the thoughts in his or her brain are shown enacted as varying scenes on, say, a wall of the room behind. A method of producing the above effect by double printing is illustrated with reference to diagram 73. Here (A) shows the "straight" part of the subject, consisting of "A" a bed on which lies the sleeper, "B" a fairly light dado running around the lower half of the wall behind, and "C" a black or very dark tone on the upper portion of the wall. Such is the subject as it is arranged for photographing, and the "straight" negative produced from it will illustrate just that and no more. Now turn to (B). Here we have a very different state of things. In the first place before going on to photograph the "vision" negative which (B) illustrates the ordinary camera mask is replaced by one having in it only a small aperture "E," so cut as to photograph a scene lying on a portion of the film which would correspond with "C" in picture (A). Having provided such a mask for the camera, we now proceed to stage our vision scene and photograph it with the small mask in place, so that the resultant negative will give the whole of the picture area "D" as blank, with only the "vision" picture

at the part "E," where the mask has been cut away. The printing of the "straight" negative and the "vision" or trick negative together superposed over the positive film will now give us a positive picture, in which a sleeper is seen in bed, while various dream pictures flash across the wall above, as may be determined by the different subjects acted when making the trick or second printing film. Whenever a "vision" scene is required to fade, the trick or second negative is replaced by a length of transparent perforated celluloid (cleaned film base). Then when another "vision" has to flash on to the wall the celluloid is joined up with another trick length of (B) negative.

Working on the foregoing system it will be seen that instead of a single negative two thicknesses of negative film have to be carried forward by the claw of the printer along with the positive stock in

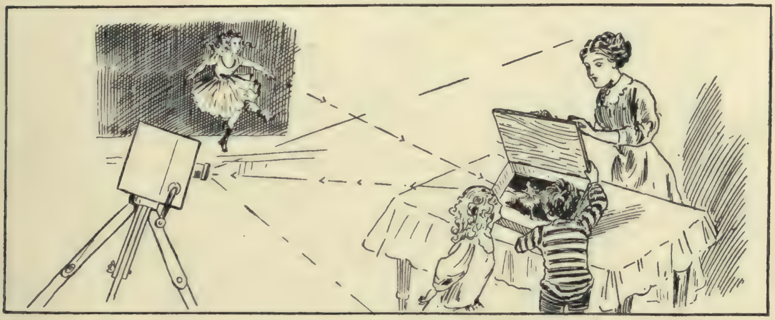


Fig. 74.—A very pretty trick effect. Mamma gives the children a magic box. On opening it a little figure is found to be alive inside. The secret lies in the bottom of the box, which is either a plane or slightly convex mirror. The fairy in the box in reality is an ordinary person so placed in regard to the reflecting mirror and camera lens as to satisfy the well-known optical law that the angle of incidence shall equal the angle of reflection of the mirrored image. The illustration makes this plain.

course of printing, the "straight" negative being always threaded nearest to the positive stock. There is another way in which double printing may be effected. It has the merit of giving sharper outlines to the "vision" portion of the print, though certain complications also follow upon working by this alternative method. Such an alternative way of going to work is to dispense with the small cut camera mask in making (B) and substitute for it a wide white frontage to the stage "E," on which is enacted the "dream" scene to be photographed. The resulting (B) negative will now have an opaque instead of transparent "D" portion. Such a negative will be used to print in upon the positive stock at a different printing from that which prints (A). In other words the negative (A) will be printed as usual for single printing. The once printed positive will then be wound back and reprinted with (B) negative in place in

front of it. Where the impression of the "vision" has to disappear, it will be necessary to use lengths of plain opaque blank spacing between the (B) subjects, instead of cleaned celluloid as in the former instance. This second system is only of use where the "C" portion of the "straight" scene is white or very light.

The number of effects possible by means of double printing is so great that a list of them would occupy much space, as well as being hardly sufficiently explanatory to be of service. Careful examination of those more modern trick subjects, which cannot be duly explained by the simpler methods, will, however, generally give the key to the form of double printing involved in their production.

Masks. Retouching.

Though hardly connected of necessity with trick work, this is thought to be the place to say a word or two about the above.

As has just been explained, picture masks for special purposes may be cut for the camera of different aperture to the usual one. Sometimes even with "straight" negatives and single printing an enhanced effect can be got by varying the mask aperture more or less from the usual and admittedly monotonous horizontal cushioned oblong. For instance, a scene may portray what is being viewed through a round window. In such a case a circular cut camera mask will photograph the subject with a round dark border on the print, which will often be extremely effective. A lady looking in a looking-glass may see her reflection portrayed as a picture cut the exact shape of the hand mirror. Other similar ways of utilising this possibility of varying the shape of the camera mask should easily come to the mind of the reader. Many modern cameras are fitted with simple means of taking out and replacing the ordinary mask with ones cut to openings of special proportions.

Retouching kinematograph film is not a matter calling for anything like the amount of remark which is properly lavished upon similar treatment in the case of still view negatives. Practically speaking, the multiplicity of tiny negatives to be dealt with in modern motion picture work renders anything like careful individual work upon each out of the question. One thing can, however, be done to a kinematograph negative before printing. What is more, it should be done and done carefully. The film length should be gone over, and any large transparent spots technically known as "pin holes," filled in with a touch of paint, applied with an ordinary small paint brush. Light red is a good coloured pigment to use for the purpose, or a special photographic preparation sold under the name of "Photofake" is excellent.

Needless to say, only such pin holes as occur in dense portions of the negatives should be thus touched out. Those occurring in places where the silver deposit is thin would only be rendered more conspicuous by filling in, and had consequently best be left alone.

CHAPTER XIII.

REHEARSED EFFECTS. STORY PICTURES.

Story pictures form the preponderating class of present-day kinematograph releases. They may be roughly classified as follows—

Comedy	Serio-comedy.	Adventure.	Farce.
Tragedy.	Drama.	Detective.	Human Interest.

Of all plots the human interest and farcical kinds are probably most sure of a good reception by any audience, while farce is almost certainly the easiest of all to put together and produce in something approaching a satisfactory manner. The typical farcical kinematograph plot is, in fact, nothing more than a glorification and amplification of the well-known music hall knock-about turn. Both rely for their drawing power on that subtle appeal to the primitive emotion of the masses, known as "biff humour." In other words they make their bid for success through the exhibition of unlimited horse play. But strange as it may seem even horse play has its psychological side which must be attended to, or it will fall flat.

Thus it is well known and accepted by all psychologists that the humour of a ridiculous situation lies chiefly in its mockery of the accepted and respectable. For instance, suppose we are to depict that oft-filmed man staggering along with a ladder over his shoulder, knocking into various people as he goes, it would not be half so funny for him to knock into a labourer trudging to work as if he drove the ladder into the stomach of a well dressed city man, thereby causing the latter to fall into a pile of road refuse or other suitable and handy means of causing his respectable clothing to be held up to mockery.

So much for the motive power underlying screaming comedy. Summed up in few words it is mockery and horse play judiciously combined. See to it that someone is always getting into bad trouble from start to finish of the film, and let it be trouble of a sort to render dignity undignified and set the laugh against human frailty, either mental or moral, so long as the joke is not of the kind to come home to roost with the audience who are to witness the film.

Films of this class are often heightened in intensity and rendered correspondingly more effective by judicious trick effects of a sort which, not being obvious, will not appeal as unreal to the observer. Thus, a man may be running from his mother-in-law, when he slips and falls down a precipice. We see his body actually come hurtling down to what would in the ordinary way be certain death. But no! In some manner he manages to cheat destiny, and gets up after the fall with nothing worse than a bruised face and bad limp. Of course

the fall is contrived by a trick already fully explained along with numerous others in the preceding chapter. At the same time such unsuspected trick effects undoubtedly add to the breathless interest of the "chase" variety of farce film.

Next to the farce in order of easiness of portrayal probably comes the adventure and detective classes of motion picture story film. The reason of their simplicity is to be looked for in the highly coloured incidents portrayed. Moreover, the bulk of modern motion picture detective films are of the Nick Carter and Sexton Blake variety. Nor should we forget, when setting this forth, that both the above heroes belong to the realms of gutter literature, and not to those of high-class legitimate fiction at all. Small wonder, then, if there is but little subtlety called for in the interpretation of plots stamped with the hall mark of Messrs. Blake and Carter. Still, even here it is essential to success that the conscientious portrayal of the smaller details should not be lost sight of. The thrills of either detective or adventure stories lose nothing of their power for being reasonably plausibly worked up.

Let us pass from the consideration of the above class of thing to say a few words about certain kinds of kinematograph story calling for exhibition of higher talents in those concerned with their production. Such types of kinematograph plot are the light humorous, the more serious dramatic, and human interest varieties. Of them the easiest one to manoeuvre to a measure of success is probably the human interest tale, only it must be really well acted, with no slips and no unrehearsed ridiculous situations to spoil it. Human interest being entirely savage—like the appeal of "biff humour"—we must not attempt to look for it outside of the emotions. But whereas humour may be regarded as the making of a brutal exhibition of some person or estate with which we have no sympathy, human interest is the ringing of the changes upon emotions and situations in real life near to the audience itself. Nor in the "strong" human story need we hesitate to lift the veil from the most private and sacred of human hopes, griefs, and attachments. It may be somewhat of a grisly business, this digging up of mouldering bones wherewith to decorate the projection screen. Still, it pays.

Love constitutes a great human interest, of course. Money has an appeal as strong or sometimes even stronger. Then there is death, horrid enough one might think, yet capable like the rest of being turned for the occasion into an unwilling pay box attendant. The ill-treatment of the old by the young who they have raised up, or the cruelty of a hard-hearted landlord to his tenant, to say nothing of themes involving cruelty to pet animals, all go to swell the human side of a motion picture film. In fact, to the man with his eyes open there is no common cause of distress which cannot be successfully played upon for the purposes of the more lachrimose type of kinematograph film.

Sometimes a film subject will rise far above the usual dead level which we have tried to depict above. When this is the case careful investigation will usually show the idea to have been taken from a more or less well known work of classical fiction. But classical or not, film plots have to be pretty well handled if they are to stand out from their fellows as worth seeing by the critical man. And here it might be well to say a few general words about sundry conditions which should be looked to in the photographing of rehearsed effects.

First as to incident lengths. The aim in all story film production is to make the pictures explain as much as possible, without the necessity for sub-titles (or explanatory sentences interspersed between the picture subjects.) A film helped out by a great number of sub-titles thereby shows itself, amongst other things, as capable of improvement either in plot or stage management. This is not to say that a sub-title may never be admitted. That would be going too far altogether toward the other extreme. Where titles or sub-titles are photographed they should be of a length of not less than six feet if a few words only are included. If many words or sentences are necessary upon a sub-title, as, for instance, in the portrayal of a hand written letter, or in giving a sketch of the story leading up to some historical presentation, the film length may well be from ten to twelve feet, or just so long as it would take an ordinary reader to go through the whole of the written matter twice slowly.

The pictured incidents themselves should never be of a length less than ten feet, or they will flash off and on the screen in an abominably jumpy way. Needless to say this remark does not apply to tableau effects. Twenty feet is a fair length for a good story incident, though this may be increased to forty or even sixty feet if circumstances seem to warrant. With long films, individual incidents may even be spun out more than this, but then there is always a danger of sameness spoiling the snap and go of the production. Such an exceptional picture incident as the telling of a ghost story might however go on just so long as the narrator's pantomimic genius enabled him to hold the audience. As to rate of turning, it should always be the same sixteen pictures a second for every subject, whether grave or gay. So many modern projectors are motor driven that an even taking rate becomes daily more and more of a necessity.

Perhaps it may be the lot of the reader who makes his first attempt at story film production to have to work with actors and actresses not accustomed to playing their parts in the focus of a kinematograph camera. In such a case there is likely to be some difficulty arising through the fact of the artists' inability to gauge accurately the limits of the stage as seen by the camera lens. With a set studio gauge the complication may not be a serious one, but when acting outdoor episodes where the action is confined to a small and important space in the foreground, one cannot be too careful in ensuring that no important bit of business takes place " off " when it should have been 'on." The way to accomplish what is necessary is by means

of small flags or tapes, planted or laid in V shape, from camera lens outward as illustrated in diagram 75. The tape lines must be just invisible on either edge of the picture mask. Chalk marks may also be made and used for a like purpose. All the actors and actresses have then to do is to be sure that they make their entrances from outside to inside the chalked or taped area, that their action is gone through strictly within the same area, and that no exit shall be deemed complete till after the outer side of the tape lines has been crossed. This will ensure acting strictly within the limits of the picture.

Probably where anything of the nature of a regular set kinematograph stage is attempted for the first time this will take the form of an outdoor one. In such a case the scenery is best painted on supported canvas, exactly after the manner of mounting and painting ordinary

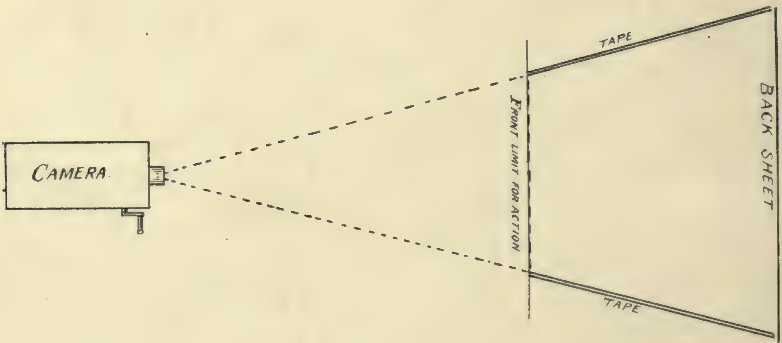


FIG. 75.

stage "flats," except that for motion picture photography we work up the original in black and white instead of colour. Flatted oil colour is the thing to use; also the "fit up," must be so made as to be easily removable from place to place and aspect to aspect, according to time of day, weather, and general circumstances, not excluding the possibility of sudden squalls of rain and wind.

Covered-in studios provided with expansive glass roofs for daylight work, to say nothing of mercury vapour light installations for photography in dull weather and at night, are hardly among the first flights of commercial kinematographic enterprise for which it is hoped this part of the book may do something to fit the prospective motion picture photographer, so it will be necessary to say no more concerning indoor work than that since here neither wind nor rain has to be guarded against, flatted oil scene painting may be, with advantage, superseded by distemper work, the latter then having everything to be said for it on the score both of speed of production, low cost, and quick drying qualities.

At the same time it might also be noted that, in order to compare in any way with the real thing, artificially produced scenery has to be of the very highest order, and since such a condition is never easy to fulfil in practice it must accordingly follow that, where Nature can by any reasonable means be made to serve, scene painting should be rigorously avoided.

For instance, we may be called upon to depict a love passage between the hero and heroine. If possible such a passage should be represented as enacted out of doors in the garden of the girl's father's country mansion, not in the drawing room which would then necessitate studio and painted scenery. Of course, it is not possible to do without such studio work entirely. Still, one should try as far as one can to get away from it, and indeed one only has to study carefully the latest and best film productions to realise more and more the trend among high-class houses to keep away from the "boxed in chamber with scenic ornaments" of olden time.

One word of advice to plot producers. It does not properly come within the limits of the present chapter, but the writer thinks it so important he cannot bring himself to exclude it. Don't let the leads "take the footlights" for every effect or incident on which the film's strength is going to depend. Why ever the motion picture stage manager doesn't put his foot down on the present prevailing and wholly pernicious practice it would be hard to surmise. Lurching into the exact centre of the picture at three-quarter length point for every telling situation is not really the way to make that situation more telling. In fact it is the reverse. The centre of a picture is admitted by art critics to be its weakest and not its strongest portion. It is half way between the middle and the extreme side that the real strength of composition lies. But there is another reason why "taking the footlights" is not going to be of any use to the picture actress. It shows up her face too fiercely in the resulting print, with the consequence that if she really be pretty half her attraction for the audience will be lost through her features being too completely seen and taken stock of early in the film picture, while if she be not quite so pretty——.

A hint on how to photograph beauty becomingly. We have just touched on a very common way in which its effect can be and is lessened in many moving pictures. The best method of doing justice or maybe a trifle more than justice to a pretty and capable female model is to photograph when feasible with the sun out and high in front of the camera. That way the features will be thrown into a very delightful silhouette, while if the sun is a trifle more to one side Rembrandt effect is the equally satisfying result. Only in trying the above beauty formula see to it that the camera shutter and gate are thoroughly dead black or there will be trouble from internal reflections.

A final word about the taking of rehearsed effects. Insist that these be gone over time and again and made absolutely perfect before there is any attempt whatsoever at photographing them. Even then,

Heaven knows, enough things can go wrong and ruin films at the critical moment. The snorting charger may gib when it should be racing the Scotch Express. The murder in the lonely wood may be ruined by the casual appearance on the scene at the crucial moment of a mildly interested tramp. The writer has even witnessed a terrible accident—the rolling of a young girl down a precipice—which was rendered so ludicrous by unforeseen circumstances that it could only have done as a roaring comic of the continental type. That represents a negligible part of the tricks Nature may play you, so don't add to them by allowing any on the part of the artists.

FIG. 76.—M. PROSZINSKI AND HIS AUTOMATIC CAMERA.

Appendix to Part I.

FUNCTIONS OF LENSES.

Lenses are in reality no more than pieces of glass which, instead of being flat, possess curved surfaces. Now it is clear that such curves may be of two kinds. They may go out, as in Fig. 77, where the lens would be said to be double convex, or they may go in as in Fig. 78, where the lens is of the double concave variety. A third class of lens extensively used in photography is the meniscus, Fig. 79, in which one of the curves goes in (concave), and the other goes

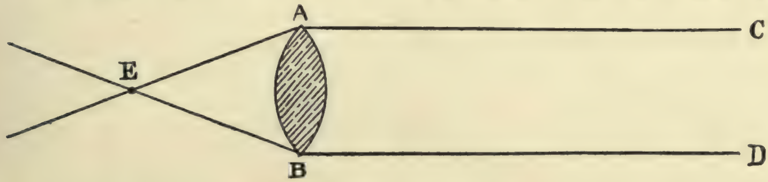


FIG. 77.

out (convex). If we refer again to Figs. 77 and 78, we shall notice that the action of the two types of lens is entirely different toward light falling upon them. In each case, CA, DB, represent parallel light rays falling on the glass. In the one case (that of the convex lens), the effect of the len's curvature upon the rays is to bend them toward a common 'focus' point at E (Fig. 77). In Fig. 78, the same rays, CA, DB, are represented as passing through the concave lens AB. But here, although a bending occurs, it has the effect of turning the light rays away from, instead of towards one another as at E, F. Since an actual or positive focus point is the only position behind a lens at which a real image of natural objects is formed, and since only lenses of more or less convexity possess this, it follows that all working photographic lens combinations are of the convex variety.

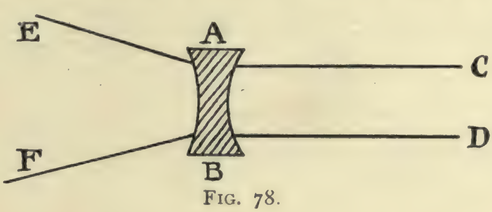


FIG. 78.

The ordinary magnifying glass is of this kind, which accounts for its ability to cast behind it an image of an object placed in front. The same attribute is also shared by any lens in which the sum total of the curvature leaves a balance on the bulge-out side. Thus, in Fig. 79, the meniscus lens, although possessing distinct concavity on the right hand side (as drawn), has even more pronounced convexity on the left hand. It would therefore act on the whole as a slightly convex lens. The same rule applies to lenses made up of more than one glass or

FIG. 79.

'element.' In considering such, then, we may for present purposes include all lenses possessing a balance on the convex side as in the same category with the double convex variety figured in Figs. 77, 80 and 81.

And now to turn to Fig. 80. This seeks to make plainer the reason why the ability of a convex lens to concentrate light rays to a point confers upon it also an ability to cast an image of objects upon which it may have been focussed. In this diagram the arrow AB must be taken as the object that is being photographed. Imagine two points, A and B respectively at opposite ends of the arrow. The arguments which can account for the production of an image of these two points applies equally to the formation of an image of every other point on the surface of the arrow or, in fact, of any other object photographed.

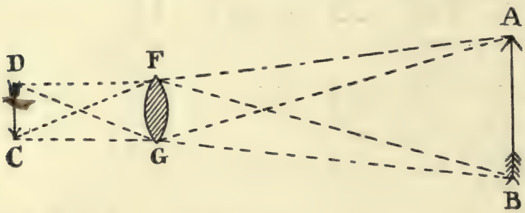


FIG. 80.

Now to reason the formation of the images of A and B. Light, as is well known, travels a straight course unless the rays are artificially turned by some substance such as the glass of the lens itself. Also, since any object can be seen from any point of view provided there is nothing between it and the observer, and provided also the intervening distance does not place too great a tax upon the observer's eyesight, it follows that light rays must be reflected from all illuminated objects in all directions. Hence, we may take it for a start, that light rays are being given off in all directions from the points A, B of the arrow AB in Fig. 80.

We interpose the lens FG anywhere within view of the points in question when pencils (portions) of light, FAG, FBG, given off from A and B, will strike upon the diameter of the interposed lens, FG. Also, these will strike the glass travelling in straight lines from A and B. Moreover, the central ray of each light pencil will follow a straight undeviated course (due to the fact that the central point of a spherical curve is theoretically a plane surface), the outer rays of such respective pencil tending more and more to meet this middle one at a point known as the focus point, which varies in position according to the remoteness of the object focussed, but we will suppose to be in the plane DC, for the object A.B. We are assuming our curved glass FG to be behaving as a 'perfect' lens free from errors of spherical aberration which often arise in practice to mar the performance of the cheap commercial article. Following this out, it will happen that whereas BF, BG will come to a focus at (say) D, (a distance decided by the focal length—or extent of convexity of the lens), the rays AF, AG will come to a point at C in the same plane. Likewise, all intermediate rays will, by the like reasoning, be brought to a focus at their proper intermediate distances. Hence, an image of AB will be formed at DC. Such then is the skeleton of the reasoning underlying the formation of the optical image used for the purpose of impressing a plate with its photographic negative record.

Notice incidentally how the inversion of the image comes about as the necessary consequence of the above. With the object photographed the head of the arrow A is upward. In its image, and as the result of the crossing of the rays in the lens, the head C is pointing downward.

While we are on the subject of lens action, it may be as well to include one more diagram, Fig. 81. This has a very practical bearing upon photographic technique. It illustrates what the text books on optics speak of as the law of conjugate foci. Looked at from the utilitarian standpoint, it shows the reason why a photographic lens has to be racked inward or outward according as we are taking distant or near objects.

The diagram illustrates two point objects, A and B, which it may be wished to bring to a focus. It will presumably have been grasped by the reader that this focal point, or position where the image is concentrated (as DC, Fig. 80), is the one at which the photographer endeavours as nearly as possible to adjust

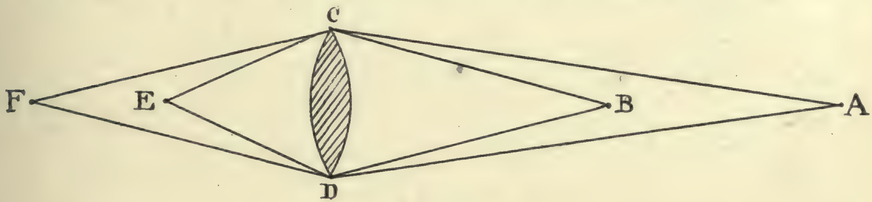


FIG. 81.

his sensitive photographic surface. Reverting to Fig. 81, it will be seen that the points A and B do not focus at the same distance behind the lens, since whereas the more distant one A, comes to its focus at E, the nearer point, B, does not reach a focus till F, much farther from the lens' back surface.

This is, in itself a rough expression of the law of conjugate foci ; that the nearer the object to the lens, the farther behind will be the focal plane of its image. Obviously, the photographer is placed by this inflexible rule of optics in something of an awkward predicament, for it is equally impossible for him either to insist on the objects of nature grouping themselves to order in one plane (distance) before the camera, or to make the vertically-supported plate or film receive truly focussed images of objects in different planes at one and the same time.

In practice, a compromise is effected by the process known as ' stopping down the lens.' This consists of placing a ' diaphragm ' or ' stop ' of opaque metal in front of the lens glass, the same stop having cut in it a small hole of a size only to allow a comparatively small pencil or rays to come through. While the above expedient greatly slows the action of the lens, and while at the same time it affords no help whatever in arriving at the optically impossible condition of obtaining simultaneous true focus of many planes at a time, it none the less makes the lens's departure from such a condition less noticeable to a degree depending upon the extent to which ' stopping down ' has been effected.

Stopping the lens is therefore very largely adopted in practical work both in the field and studio, and in that connection is more fully treated of in Chapter 4. For the present, it will be sufficient to append Fig. 82 by way of illustrating the theory underlying the action of a diaphragm as used for the above purpose of producing apparent ' depth of focus.'

In Fig. 82, the object A is represented as being brought by the lens BC to a focus in the plane GH, at which plane, needless to say, the sensitive surface should be placed to receive the image formed. Suppose instead, that by virtue of a greater necessity accurately to focus some still nearer object, the photo-

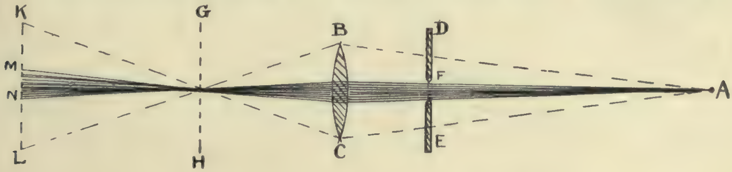


FIG. 82.

graphic plate or film has had to be moved back to the plane KL. Then, without the interposition of a stop, the image of the object A would be hopelessly blurred, each point of the original having expanded into a wide circular patch of light as KL. This is the condition of things indicated by the broken lines. The black

cone sets forth the improvement introduced by the interposition before the lens of the diaphragm DE, containing in it the small aperture F, through which alone the actual utilised light cone passes. As before, we see that the true focus point remains at GH. Shifting the sensitive surface back to KL, however, now only introduces the much lesser blurring effect formed by the comparatively slight diffusion of the light rays from point formation as at MN.

The above optical notes do not pretend to do more than touch the fringe of a very wide and intricate subject, one, moreover, which is in its advanced stages right outside the scope of a work on practical kinematography. The reader who may wish to go further into the theory of photographic and other lenses is for this purpose, and as a first step, recommended to the perusal of such a well-known elementary optical handbook as Glazebrook's "Light."

NOTE ON FILM STOCK.

Needless to say, the best way of handling ribbon of all sorts in small compass is by rolling it up. It is in the form of a roll that the necessary long strips of photographically-coated celluloid, known as 'film stock,' are sent out by the manufacturers. For use, these rolls are loaded into suitable containers within the camera, from thence to be fed into the escapement as required. The usual lengths of commercial rolls of film stock are 165 feet (Continental) or 200 feet (American and English) lengths. The width of such stock is approximately one and eleven-thirtyseconds inches.

FILM MASKINGS.

The "masking" or registration of a film is a technical term expressing the relation of the perforations to the pictures. Thus a film may have its masking such that the top edge of a perforation coincides with the top edge of each film picture as in *A* fig. 83. Or the masking may be of a kind where the centre of the topmost perforation of each picture space is nearly a quarter of the picture length down from the top of the picture as in figure *B*. The masking may, moreover, be anywhere between these two extremes, according as the camera mat is adjusted.

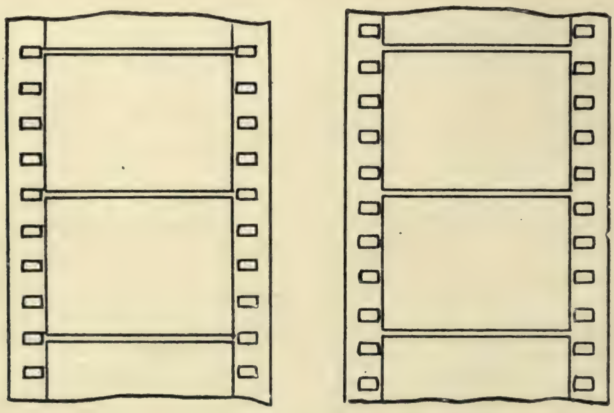


FIG. 83.—DIFFERENT MASKINGS OF FILM.

It is in order to compensate to some extent for variations of masking in the negatives that the printer is provided with an adjustable gate. At the same time it should be clearly understood that adjusting the printer gate will not make

up for variations of masking in the cameras, wherewith two different negatives have been made in so far as the question of joining prints from these negatives together is concerned. In other words, where prints from two negatives of different masking are joined to form one positive film, the point of junction will always necessitate double adjustment of the projector gate whenever the composite film length is put through.

Consequently it is very important where film subjects are being produced to see that only cameras with similarly registered gate masks are employed upon the production of the negatives used. In this way alone can it be ensured that the one adjustment of the projector mask on starting the film will do for the whole run.

Where positives are to be made in the camera, the absence of an adjustable gate makes it imperative that all negatives printed from it shall have been taken either through the camera itself or at least by the aid of one with identical registration.

PERFORATING.

The private man, or the one starting filming on his own, should attend carefully to the following points. Have all motion picture cameras on the premises as far as possible identical of construction, having the same movement with pins or claws of one calibre, and see that all picture masks are set in the same relation to the sprocket holes. Have your perforators made to the exact gauge of the camera sprockets, with punches as nicely proportioned as possible to the claws of cameras and printers. This will materially improve the steadiness, and therefore the quality, of the film subjects you issue. Your positive stock should, however, have its perforations large enough to fit easily over the sprockets of commercial projectors.

QUINONE INTENSIFICATION OF NEGATIVES AND POSITIVES.

Quite recently (December, 1910) Messrs. A. & L. Lumiere, the well-known manufacturers of kinematograph negative and positive stock, have published the details of a new form of combined intensifying, toning and hardening bath, which may very possibly turn out to be of great use in the treatment of topical negatives and positives.

The formula for the bath is as follows :—

Quinone	6 ozs.
Potassium Bromide	2 lbs.
Water	60 pints.

Note.—The Quinone referred to above is otherwise known as Benzo-quinone. It is not the same as Quinol (which is another and synonymous term for Hydroquinone.)

On placing film in the above bath it gradually changes in colour to a dark, reddish brown, also gaining in intensity. Further changes of colour and density may be produced by after treatment, according to the following table. In each case the after treatment is to take place upon the Quinone toned image.

PLACE IN TEN PER CENT. AMMONIA.

Image tones dark brown and becomes still further intensified. After drying, the colour goes back somewhat to the original Quinone tone, but the further gain in intensity remains.

TREATMENT IN CARBONATE OF SODA SOLUTION.

Tones image pure dark brown, with great intensification.

PLACING FILM IN "HYPO."

Reduces the image, making it very transparent, but still of the reddish brown colour, to which the Quinone toned it.

TREATMENT IN SODA SULPHITE SOLUTION.

Tones image greenish brown, without affecting the depth. In any case it will be found that the film, after Quinone treatment, is hardened, just as it would have been by immersion in a formalin bath. Thus the topical worker has placed in his hands a quick and simple means of simultaneously toning, hardening, and modifying the depth of image of a quickly printed and consequently faulty length of positive film which there may be no time to duplicate.

CAMERAS USING NON-PERFORATE FILM.

Although cameras using perforate film constitute the only type of present-day commercial instrument (so far, at any rate, as sales are concerned) it has always been recognised by those interested in kinematography, that were it possible to impart a steady intermittent movement to imperforate film, great advantages might accrue in the matter of motion picture taking and printing.

For one thing imperforate negative and positive film would certainly expand and contract more evenly and uniformly during development and subsequent drying than does the present perforate stock. Also whatever alteration occurred to the film, through strains in course of treatment, would not effect its perforations if these need not be made in it till after all other operations of production had been completed.

The subject is one for the earnest attention of film producers interested in the subject of steady projection.

As to attempts practically to fathom the matter of using unperforated film, the reader is referred to Hopwood's "Living Pictures," page 128, where he will see such an arrangement figured (fig. 142.) A suggestion for projecting imperforate positive film also occurs in Hepworth's "A B C of Kinematography" (published 1900) though the practical advantage of extending the above idea to projectors might, or might not, prove so great as was there anticipated.

END OF PART I.

PART II.

PART II.

Projection.

CHAPTER I.

THE ELEMENTS OF PROJECTING.

The problem that confronts us in kinematograph projection is, apart from consideration of the escapement of the machine, practically no different from the one encountered in working an ordinary optical lantern. In fact, the kinematograph projector is merely the combination of the elements of an optical lantern with the escapement necessary for actuating the moving film. The intermittent motion, in so far as it applies to cameras for moving picture work, has already been gone into, and this broad principle remains little if at all altered in its application to projection instruments. We will therefore now introduce the projector firstly as an optical unit for the transmission and concentration of light rays through the kinematograph film and on to the projection screen. Discussion on projector escapements will follow.

The main spring of the projector's optical system is to be discovered in the lantern body. This is simply a roomy fireproof case, generally of asbestos lined iron, designed for the reception of the light source. Limelight or the electric arc usually provide the actual illumination within this lantern body, the light rays falling upon the 'condenser,' situate as shown B, Fig. 84, which consists of a combination of more or less crude lenses mounted in a metal cell, and so arranged as to bring the light from the light source A to a partial focus on the projector gate C.

In this gate the film moves, just as in the gate of a kinematograph camera, the light passing through it and being further collected by

the objective lens D, which performs the function of forming the transmitted rays into the image on the screen.

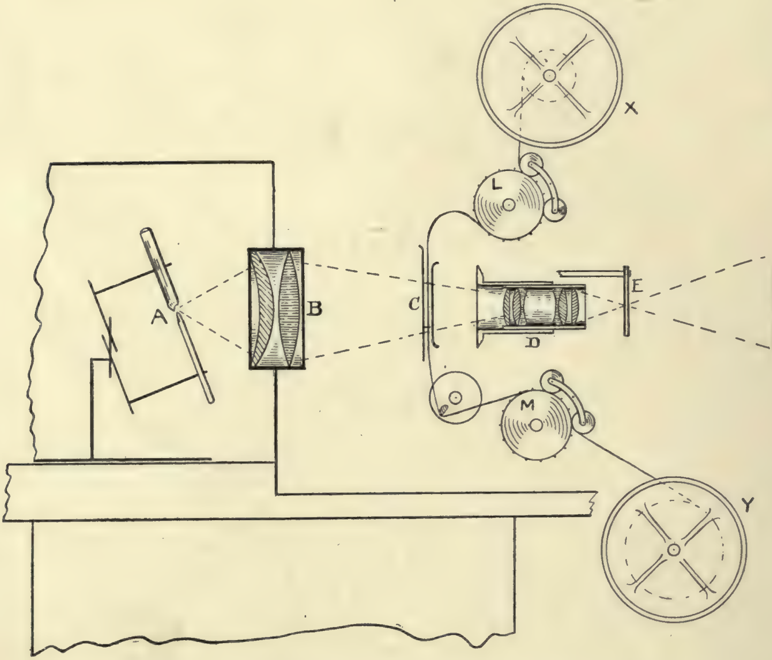


FIG. 84.—THE PROJECTOR AND ITS OPTICAL SYSTEM.

The condensing lens usually employed in projecting moving pictures has a diameter of 4 to 4½ inches, and is either a triple condenser or one of the Herschel type, this latter being a combination of two lenses, the back one, or that nearest the light source, meniscus, and the front one nearest the gate, a double convex (Fig. 85). The objective lens is nearly always of the Petzval portrait type, consisting of a single cemented front combination and an uncemented back combination formed of two thin lenses separated by an air gap. When cleaning these Petzval lenses, rules to remember are to place the uncemented elements in their right order nearest to the gate of the projector, not to omit the metal ring which determines the width of the air gap in the back combination, and last, but not least, to load in all lens elements with their greatest convexity towards the projection screen. This will ensure a correct performance for pretty well all objective lenses commonly met with on a projector.

FIG. 85.

One thing will probably strike those who glance a second time at Fig. 84, and who may be accustomed to operating the ordinary still view lantern. That is the great distance of the condenser from the film in the gate. The reason for it is the comparatively small size of the kinematograph picture with the consequent necessity for concentration of light from the condenser into a small beam in order to waste as little of it as possible. Beyond this, there is really no fundamental difference between the optical arrangement of a still view and a moving picture projector.

Concerning the manner in which the condenser brings the light rays from the illuminant to a partial focus on the gate, as also the optical effect of the objective to form the image on the screen, this should be fairly plain to those who have read the remarks on elementary optics in the appendix to the first part of this book. The condenser lenses are crude and uncorrected, but they perform their function by bringing the bulk of the incident light to a partial focus on the positive film picture. From the point when this more or less parallelised light beam emerges on to the back glass of the objective the condenser's use is over. The objective proceeds to build up the image on the screen according to the laws of refraction of light. The law of conjugate foci will explain the formation in this instance of a large and distant image by means of a short focus lens. When photographing a natural object with the camera the lens is used to concentrate distant rays to a focus upon the negative film, which is then comparatively close. Large external objects, under these conditions, and following the law of conjugate foci, give a small compact image. In projection work we simply have the case in which distance and consequent comparative size of object and image are reversed. Reference to our conjugate foci diagram will make the matter easier to understand. (Appendix Part I.)

Further, as in photography, so in projection, the focus of the objective lens decides the size of image we can obtain. Thus, a two inch objective will give a clearly focussed image of twice the diameter of the one thrown by a four inch objective at the same distance. This, too, will be found absolutely analogous and explained by the diagrams and remarks on focus of lenses in our first part. But in projection it will be necessary when deciding upon the actual size of the picture to be thrown on the screen to bear in mind a law of light known as the 'law of inverse squares.' This law does not come obviously before one's notice in practical form in kinematograph photography. In projection, however, it is very important, since it is our one means of working out the comparative illumination of screens of various sizes for a given illuminant of known power.

The law of inverse squares may be stated as follows: 'The intensity of light proceeding from a small source is inversely as the square of its distance from that source.' Thus, to state the matter in practical form, the effect of doubling the diameter of the projected image thrown by a given lens with unvarying light source will be to make the illu-

mination of any given portion of the picture, not one half, but one quarter of the former brightness. Enlarging the projected image three times (either by shifting the screen farther away from the projector or using an objective lens of equal aperture but one third the former focal length) will cause the brilliance of the picture to diminish nine times, and so on.

Bearing this rule in mind, it will be easy for the kinematograph operator to determine at any time whether the light at his disposal will or will not allow of any given enlargement of the projected image. Later on in the book will be found precise tables tending to give more definite help along the same lines.

Having now outlined the general optical arrangement of the projector, and before passing on to deal with any particular points wherein its escapement may differ from that usually associated with the kinematograph camera, it may be as well to touch briefly upon other parts connected with the movement of the celluloid film through the machine. Such parts will be the feed and take-up spools, the spool arms and spool boxes, feed and take-up sprockets, and the rotary light shutter. Referring to Diagram 84, X, Y are upper and lower film boxes holding respectively the film and take-up spools ; L, M are upper and lower or feed and take-up sprockets, and E is an end-on view of the rotary light shutter, which should not be confused with the sliding light cut-off fitted in practice directly in front of the condenser, and which latter being an article of practical utility rather than a fundamental item of projection will be neglected for the moment.

The film feeding and taking up mechanism consists firstly of a spool arm fixed to the top of the machine, and carrying a rotating and easily removable metallic spool or reel upon which the film to be exhibited is wound before showing. This rotating spool is enclosed in a fireproof box, having a suitable slit in it fitted with some fire extinguishing device, usually a system of rollers, through which the easily inflammable film is led to the top or feed sprocket. It is the rotation of this sprocket, actuated by means of gear wheels, that drags the film off the top spool and feeds it uninterruptedly into a loop on the top of the gate. From this moment the downward motion of the film becomes intermittent, being actuated thenceforward by the escapement, till the film is picked up again uninterruptedly on the bottom sprocket of the kinematograph, from which it is fed to the second, or take-up spool on the lower spool arm of the projector.

This take-up spool, like the feed spool, is a metal reel enclosed in a fireproof box with snuffer device to prevent fire passing through the entrance slit in the event of the combustible film firing in the gate. Unlike the upper spool, however, the take-up has to be driven forward by means of chain or worm drive from the gearing of the projector mechanism acting on a friction clutch bearing against the take-up reel. In this manner all slack is successfully picked up by the bottom spool as soon as it is formed, while yet the ribbon film is never at any time subjected to sufficient tension to snap or damage it.

Now comes the turn of the rotary light shutter. What happens upon the screen when a 'moving' picture is exhibited is that a still picture is flashed before our eyes for something less than a twentieth part of a second. The revolving light shutter then cuts it off by rotating into the path of the light beam from the lens. The screen becomes momentarily completely darkened while the escapement moves another picture positive into the place of the first in the gate. Upon the shutter flicking once more out of the track of the light beam this second picture flashes before our eyes in place of the first for a similar brief interval of under the twentieth of a second. These are the actual facts when moving pictures are projected.

Yet even with the first crude projectors this was not the effect communicated to the brain through the retinal nerves of the eye, while with most modern instruments there is left upon our consciousness neither the sensation of jerky movement, nor any sense of momentary transition from light to darkness. In fact, it comes to this, that while kinematograph photography is a plain sailing sort of thing, projection and the success of it depends upon an illusion of the brain brought about through some universal weakness of our visual capacity, whereby we may trick ourselves into seeming to see what is not there. We flick still pictures illustrating the successive movement phases of an object before our eyes, alternating these brief impressions with fractional moments of complete darkness, and as the result, what we seem to be watching is an evenly illuminated reproduction of the movement of nature. This illusion is brought about at will by the intervention of the celluloid positive film as actuated by the kinematograph projector. Clearly, the why and wherefore of it calls for some attempt at explanation.

Accordingly, our next chapter will be devoted not only to remarks on projector mechanisms, but also to some consideration of the nature of the particular and fundamental optical illusion of kinematography which they call into being.

CHAPTER II.

PERSISTENCE OF VISION. THE ESCAPEMENT.

The essential phenomenon underlying all kinematographic projection is known in optics as persistence of vision. At the beginning of Part I. short mention was made of certain experiments of Ptolemy, the Greek philosopher, which bore on the subject. Beyond such passing notice, little has up to now been said by us of the relation of 'persistence' to kinematography, chiefly because the question assumes no practical significance during the making of negative and positive film subjects. The moment, however, we come to projecting a moving picture, persistence of vision takes its place as the main consideration controlling the performance. Accordingly, before we go further into the practical side of projector mechanisms, it will be necessary to examine this new theoretical consideration somewhat more carefully.

The phenomenon is most simply demonstrated in the well-known fire circle effect produced by a waving torch or burning brand. Everyone is aware that after a certain rate of speed has been gained, the whirling flame seems to the eye to spread out into a complete ring, or to form itself in seemingly perfect loops and spirals, according to the way such a burning torch is being brandished. In other words, the rate of motion of the flame has become so great as to bring about an optical illusion. We seem to see it lingering in a particular spot after it has really passed well away upon its swinging course. The effect of the bright image lingers in the retina of the eye after the actuality has disappeared; the verity has gone, but its echo exists in the retinal nerves for a short while only, yet long enough to befog the brain into imagining it has perceived complete fiery shapes where they have never really existed.

Precisely the same thing holds good with moving pictures. The photographer takes picture after picture on a band of celluloid. The operator throws successive brilliant images of these little pictures upon the screen, constantly shifting a new picture into the place of the last, in a series of rapid and regular jerks. And the audience watching the effect are willingly deceived by the phenomenon of 'persistence.' The dark intervals when the lens is at cover fail to impress the brain by reason of their shortness. So, instead of an endless series of isolated snapshots being apparently thrown on the screen, there seems only the one persisting picture—persisting except for the minor differences of movement phase between the successive images of moving objects impressed upon the celluloid length. So much for the purely theoretical aspect of the thing. Now to consider

those points in which the construction of a good projector should differ fundamentally from that of a kinematograph camera so that the phenomenon of persistence, admittedly of no account in camera work, may be given full play on the lantern screen.

Clearly we shall be helping the persistence illusion best by putting as little tax upon it as possible. There is nothing in this world that does not gain by being worked lightly and with consideration. Moreover, persistence of vision is at its height immediately after the withdrawal from the scene of the bright object causing it, in this case the projected kinematograph image. It then takes a dying-down course, occupying a total duration of from the tenth to the twentieth part of a second, by the end of which time the illusion has, practically speaking, come to an end. The moment when the rotary light shutter of the projector comes into play, after showing one kinematograph picture and before the next, persistence is at work, so that to tax the same phenomenon as little as possible the rate of picture change must be quick. In other words, the opaque portion of the rotary shutter must occupy only a small sector of a circle.

With the kinematograph camera, it will be remembered, rate of change is conveniently set at about one to one, that is to say, the cover period during movement of the film is of about the same duration as the period while it remains at rest for exposure. Even then, as often as not, it is found convenient still further to close the exposing aperture of the shutter. This may well make the effective duration of change, as compared to exposure, nearly as two to one. In designing a projector, on the other hand, three quarters exposing interval to one quarter cover period is considered a very low rate of change, while six, or even eight times the period of exposure to that of cover is reached in various projectors now on the market.

Practically speaking, it has not, so far, been found possible to make the rate of change in a modern projector greater than eight to one, for the reason that the intermittent travel of the film would become so rapid, and the grip upon it so sudden as unduly to augment the danger of breakage in the gate. Even so short a cover period as eight to one has, however, been found in practice to leave the phenomenon of the gradual dying down in intensity of persistence of vision sufficiently in evidence for a distinct flicker to be noticeable while projecting a kinematograph positive on the screen.

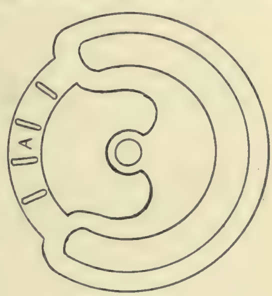


FIG. 86.

Several devices were invented in the early days to overcome this well-known defect. One of the first of these devices, invented and figured by Mr. Cecil M. Hepworth in his little book, "The A B C of Kinematography," and here reproduced (Fig. 86), took the form of a partially perforated cover shutter. The perforated grid A, formed

the cover sector of the shutter. Such a device, by lightening the screen somewhat during the dark period, certainly did relieve flicker, but it had the compensating disadvantage of bringing about 'ghost' or blurring of white outlines against dark backgrounds due to the moving film not being completely masked while being actuated by the escapement. A more recent and still very generally accepted way of minimising flicker has been, not by experimenting with the regular light intercepting shutter blade, but by balancing it with a 'non-flick' fishtail of violet celluloid or gelatine attached to the shutter shaft so as to cross the light beam at the moment when the regular cover sector reaches the middle of its off position. Of course, such addition of a violet non-flick blade cuts down the total period of lighting of the image on the screen. But here comes in an interesting point. The second minor light flicker thus deliberately introduced has the effect of greatly lessening the apparent fierceness of alternation between light and darkness on the projection screen. A moment's thought will explain the reason of it. What we do in reality by the addition of the non-flick blade to the shutter is to call in the phenomenon of persistence a second time to help its own self out by levelling our perception of light on the screen throughout the picture projecting cycle. Fig. 87 illustrates the rotary shutter fitted with non-flick blade.

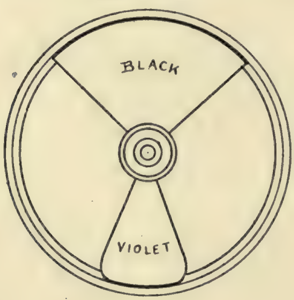


FIG. 87.

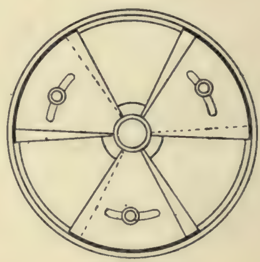


FIG. 88.

In some projectors, this same system has been carried to the length of fitting a shutter having in it three cut-away and three metallic portions. Here the light passage is deliberately interrupted twice between each necessary covering period for picture change, and in practice the resulting frequency of alternation between light and darkness proves itself so much too fast for the human eye to record that no apparent damping down effect is observable in the persistence phenomenon, and consequently flicker is very perfectly eliminated (Fig. 88). A third way of bringing about absolute freedom from flicker in kinematograph projectors is by making the covering sector of the light shutter twice as wide as usual, and revolving it at twice the ordinary speed. The loss of light is nearly the same as when working

with an ordinary shutter fitted with compensating non-flick blade, but the effect on the screen is better.

Coming now to the consideration of the intermittent mechanism, we find for one thing that the kinematograph projector differs from the camera in its movement in so far as, while in cameras absolute steadiness is the first essential, and quick rate of change not a considerable item, in projection matters are just the other way about. Thus, where the projector has a movement of the pin type, the pins will be set to act with the greatest possible abruptness and celerity, even at the expense of moderate extra strain on the perforations of the film. But in kinematograph projectors we find two other well marked types of movement in use beside the pin or claw escapement, notably the maltese cross and the dog or beater movement. Of the two, the cross is a modified pin movement depending for its action on a system of check wheels similar to the well-known Geneva escapement of a watch. The maltese cross is, in fact, practically nothing more than this Geneva escapement adapted to kinematograph purposes. Fig. 89 gives an idea of the principle.

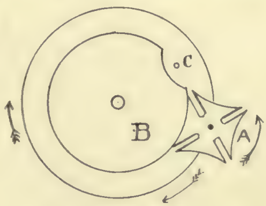


Fig. 89.

B is here a continuously revolving disc having a curved portion cut out of its periphery, while A is the cross itself fixed to the shaft of a four picture sprocket, and cut so that the in-curved faces of the cross fit tightly, yet without pressure, upon the rim of the disc B. In the position indicated in the diagram it will be seen the cross, and thus the four picture sprocket with which it is connected, is not only at rest but actually locked against the rim of the continuously revolving disc. This state of things will continue until the cut-away portion of the latter comes underneath the cross. When this happens, the lock is released, making the cross free to move a portion of a turn. At the same time, the pin C, revolving with the disc B, catches in the slot at the left hand top corner of the cross. A must now move in the direction of the arrow for a quarter turn before the pin C is released from the slot, and by the time this movement is over the disc B will have so far continued its rotation as to bring the locking portion of its rim back under the cross. It will thus be seen that, practically speaking, the cross is locked both when at rest and during the period of rotation. Consequently it follows, when the parts are accurately made and fitted, the movement is as perfect as any escapement actuating a single pair of pins can be. Formerly the Maltese cross suffered from the two great disadvantages of noisy action and want of durability. Both these drawbacks have latterly been overcome by arranging the escapement to work in an oil bath. The addition of a hardened steel roller mounted so as to revolve freely upon the pinion C still further eliminates the clatter which would otherwise result from the striking of C upon the inner sides of the radial slots of the star wheel at the moment of engagement.

A further advantage of the Maltese cross is that the four picture intermittent sprocket which the cross actuates,and whereby the downward shift of the film is made at the moment of change,may be placed very close beneath the film gate of the projector. Thus minor shrinkages in the positive stock due to strain during development, heat in the gate during projection, and such like causes do not tend to make the projected image shift up and down to the same extent as would be the case if any considerable length of film intervened between the gate and the movement device, as in the case of the dog or beater pattern projector about to be described.

At the same time, and although the dog type of movement has for long been recognised as not quite so steady as a good example of the pin or Maltese cross type, this also is in great demand, especially in the lower priced forms of projector, and where machines are intended primarily for hard and rough usage. Where a kinematograph is going to be used long and often, tended by a none too careful operator, and condemned to live its life touring abroad or in some comparatively small town where repairing and renewing of worn out parts cannot be conveniently undertaken on the spot, then the dog projector is, and will probably long remain, the one and only thoroughly reliable model.

In principle, the dog strikes out a type of movement on its own, known as continuous in contradistinction to the intermittent movement of a Maltese cross. This means that in the dog type of escapement, though the film travels in jerks its actuating mechanism does nothing of the kind. Nor is there any locking of parts at the various phases of the movement cycle, nor does any part of the mechanism come abruptly to rest and as quickly resume a high rate of speed. Naturally, therefore, the dog is incomparably simpler than any other movement at any time introduced for kinematograph requirements. Fig. 90 shows it in diagram.

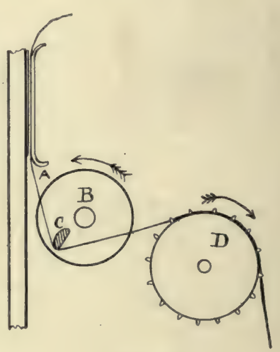


FIG. 90.

A is the film seen emerging from the film gate. D is the lower or take-up sprocket wheel revolving continuously in the direction of the arrow. Over this sprocket wheel the film passes, following a course in the track of the dog roller C, revolving in contrary direction upon the disc B. A few moments' study of this diagram will convince us as to the actual state of affairs when such a movement is in operation. The film will be constantly wound up or tightened by the take-up, this one action proceeding continuously and at an even rate. Meanwhile, the eccentric dog roller will strike the face of the film intermittently, drawing or beating down through the gate a certain length at each stroke and this at a rapid rate. In practice, the length so beaten down is adjusted to the height of a kinematograph picture, so that each blow

of the dog makes one picture shift. Further, the rate of turning of the lower sprocket D is so adjusted that a like space of film is just wound up by the time the beater descends for its next blow. Thus we have arrived at a state of things where our intermittent picture shifting is accomplished through the means of mechanism continuously revolving in the one direction. Nothing could be simpler that this solution to the problem of actuating the kinematograph film in the projector gate, and nothing could be more reliable up to a certain point. But though the dog form of movement wears well, and major troubles in working seldom occur, the effect at its best is undoubtedly inferior to that of the Maltese cross also at its best. Nor is the reason far to seek. For one thing, the Maltese cross locks the film between each shift, but the dog movement depends entirely for its steadiness on the friction of the gate springs tending to prevent after-slip in the film, the latter arrangement being obviously the less accurate of the two. Consequently, the residual movement of the film, which it makes by its own impetus in the dog machine in the absence of such definite locking action between picture shifts, becomes an item of uncertainty in the performance of the dog projector. Crinkles in the celluloid will affect the steadiness of the projected picture to a far greater extent than when the Maltese cross escapement is in use. Even minor differences in thickness of various portions of the film base will be recorded as slight up and down swaying irregularities of the projected moving picture. Rate of turning, and jerkiness due to hand turning will likewise all affect picture steadiness—in this case through the film's shift being partly dependent in its extent upon the momentum of the dog acting upon its inertia. The necessary comparatively long interval of space between the dog and the bottom of the gate has already been pointed out as a further source of unsteadiness in projection.

All the same, speaking practically, the dog projector proves itself in use to be much better than the above considerations taken together would tend to make it seem. Where a rough and ready knock-about machine is required it still holds its own both for economy of first cost and of running expenses.

Beside the foregoing types of escapement for actuating the intermittently moving celluloid positive film, there are several which should not go without some mention, though at present, as far as the writer is aware, they are being put to no very practical use in the moving picture world. The intermittent grip movement, in which two wheels are set, one on either side of the film below the gate, and having parts of their circumference cut away so that their rims only come together and grip the film (thus drawing it down) through a small portion of their revolution, is a case in point. Undoubtedly, though this particular arrangement came to no practical use, it embodies a principle which may yet show itself to good purpose in kinematography. The split screw type of movement was also undoubtedly a sound one, though unfortunately at the time it saw the light, prices

of projectors ruled so low as to cause it to be abandoned, largely through the expense of construction. Still, the Lumiere pin movement, and especially the adaptation of it now to be found in the Kineto type projector, shows a certain affinity with the split screw idea.

Perhaps the worst thing that can be said of the old fashioned kinematograph projector movements is that they were not designed sufficiently with the view to easy repair, adjustment, and renewal of worn parts. Some modern makes of bioscope also show the same defects, and very glaringly, too. Thus, the best advice that can be given to the would-be buyer of a new projector is to make sure not only of its performance in the present, but also as to there being reasonable facilities incorporated in its construction for taking up and making good future wear on the escapement parts. As to the latter point, careful examination of a machine or two will soon show the buyer with a turn for mechanics what chances there may or may not be for remedying the inevitable effects of constant use. Bushings and spindles, for instance, should not only be hardened, but removable for renewal. The same applies to dog rollers, Maltese cross parts, and even to the continuously moving sprockets, especially in the case of dog machines where the steadiness of projection is quite as dependent upon the gate springs and the take-up sprocket as upon the dog itself.

In cases where the projected image thrown by a dog machine develops a sudden and unearthly kick, it is generally a sign that the gate springs or runners are at fault. Examination of them will almost certainly reveal extensive wear, together with more or less uneven spring tension. Set this right, and the kicking trouble will probably cease. Where, however, the trouble with a dog machine takes the form of an upward or downward roll of the picture on the screen, it may be looked upon as certain either that the gear wheel teeth are faulty (gear wheels have to be particularly accurately cut for use on dog projectors) or else the take-up sprocket has had a blow and thus been thrown out of truth. A loose and rattling dog roller may also prove the cause of unsteadiness.

A rythmatic up and down motion with a cross projector means usually wrong spacing between the pins on the four picture intermittent sprocket, or of the radial slots of the cross while kicking effects are almost always the outcome of wear on the edges of the cross itself. We assume the films to be properly perforated to start with. So much for projectors, considered as a whole. The next chapter will deal more particularly with certain well-known makes at present on the English market, and it is to be hoped, therefore, that the perusal of it may prove of value, as well as merely of interest.

CHAPTER III.

PROJECTORS AND ACCESSORIES.

The cheapest projector that we know of which is designed to take full-sized kinematograph film, and is not a toy, is the Empire Home Kinematograph, model 00 (fig 91). This is a dog machine, fairly solidly

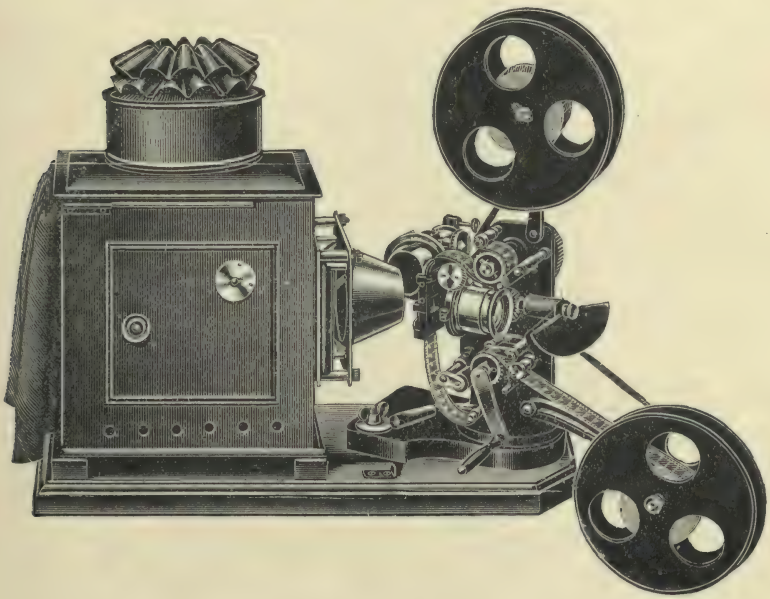


FIG. 91. BUTCHER'S EMPIRE HOME KINEMATOGRAPH.

constructed and capable of giving a very good account of itself at home or in the schoolroom. The lantern body is of a size to accommodate a high power limelight jet with comfort, while the projector is fitted with swing-over movement, by means of which an ordinary lantern lens in rack mount can be brought before the condenser for showing still slides, announcements, and titles. The 'Empire Home model 00' is, in fact, a small and lightly made edition of the accepted and approved dog pattern projector, so well known and widely used for many years past. Its price is £5 15s.

Those desiring a machine of the Maltese Cross type for home use or experimental purposes, can find their wants satisfied in the Ernemann Home Kinematograph. Like the Empire machine it is, broadly speaking, a model of larger star wheel projectors. The Ernemann Home machine is, moreover, fitted with a three-bladed light shutter, by means of which flicker is practically done away with, while the escapement is particularly solid and accurate for so small a projector. Altogether, it is quite marvellous value at the price of eight guineas, which is all the makers ask for it.

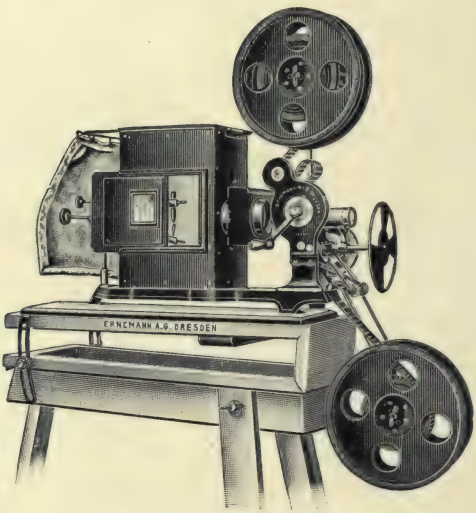


FIG. 92. THE ERNEMANN HOME KINEMATOGRAPH.

For those in search of a professional machine, however, either of the dog, cross or claw movement description, it had better be said at once there are none such (at any rate, as regards projectors with a maker's name behind them) to be had under a twenty pound note. Having stated that much, we will turn to a consideration of a few of the standard models of the present day. Generally speaking, prices for the complete projector, with take-up, spool boxes, lantern house, base and stand, range from rather under £30 to something over £40.

Illustration 93 is of Beard's Theatre Model projector. It is a professional type dog machine of first-class workmanship and construction, put out by the makers of the world-famous Beard's oxygen regulator. The Theatre Model Projector is no newcomer, but a revised and improved version of the Patent Perfect Projector which has won laurels for itself in years past. Among other important features,

it has a special film masking adjustment consisting of a jockey roller between the dog and the bottom sprocket. This jockey is controlled by a lever (shown as the lowermost one in the illustration) by means

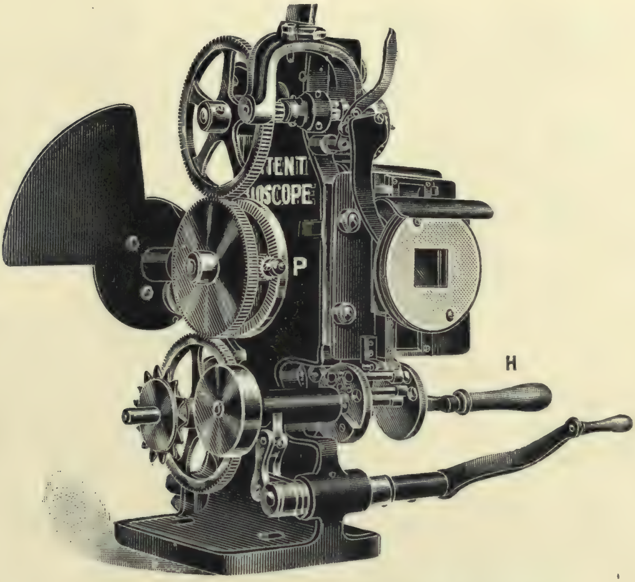


FIG. 93. BEARD'S PATENT PERFECT PROJECTOR.

of which masking can be performed quickly and accurately without in any way interfering with the centring of the illuminant in its relation to the objective. The device is picked out for special mention as typical of the many advantages of the above machine.

With our next illustration (94) we come upon yet another different type of mechanism. In short, in the Kineto Model B Projector, we have what is practically the claw escapement of the motion picture camera adapted to throwing moving pictures on the screen. The Kineto Model B, as illustrated, is fitted with a rotary shutter of the well-known type in which a single cover blade is compensated by a violet non-flick fish tail. Yet the absence of flicker is phenomenal, the reason for such being found in the enormously high rate of change incorporated in this particular projector. By means of its quadruple claw, the film is shifted in the gate in but a comparatively small fraction of the time occupied by the complete escapement cycle, so that even without a non-flick balancing blade the period of light to darkness on the screen is very great. For this reason, the Kineto projector, divested of its non-flick addition, should possess a strong appeal to the exhibitor

using limelight. The claw escapement is almost silent in operation, while as for steadiness, it is only necessary to remind the possible purchaser once again that the pin or claw is the form of escapement universally

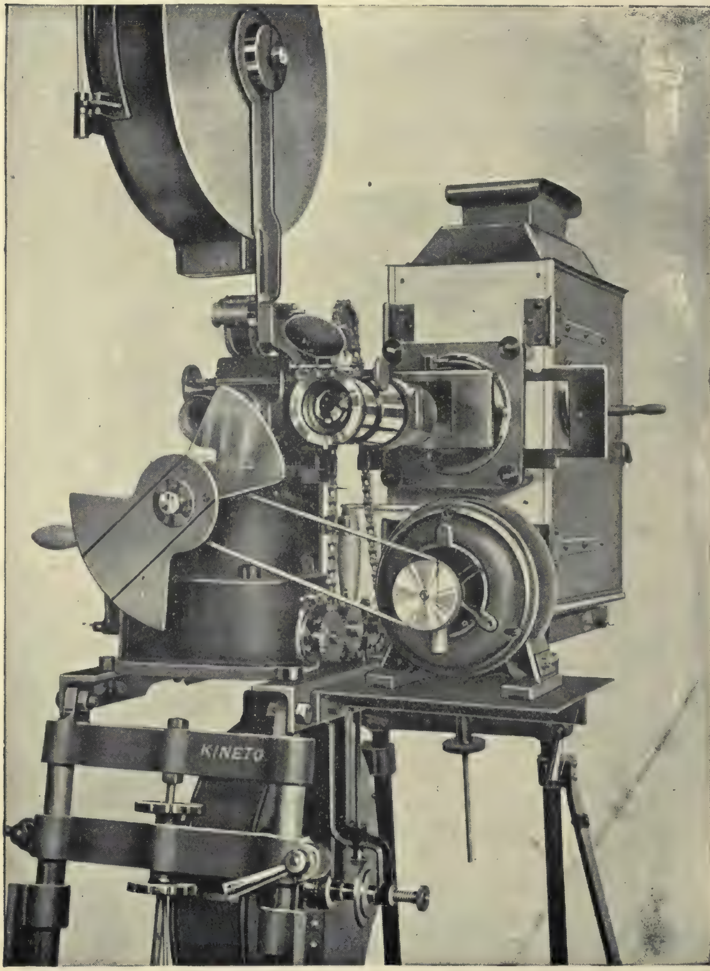
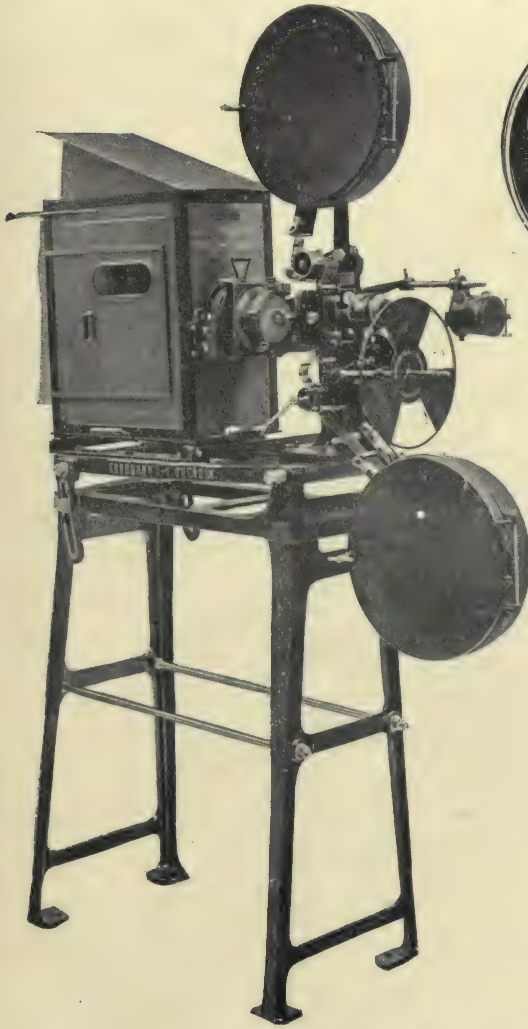


FIG. 94. KINETO MODEL B PROJECTOR.

chosen for present day kinematograph cameras for this very reason. The general get-up of the Kineto projector is imposing, as may readily be seen from the photograph printed above.

Perhaps of all silent machines, however, the palm should be given to the TYLER-ERNEMANN (shown in illustration 95). The Tyler-Ernemann also goes by the name of the 'All Steel' projector, a title which should sufficiently indicate its durability and hard wearing



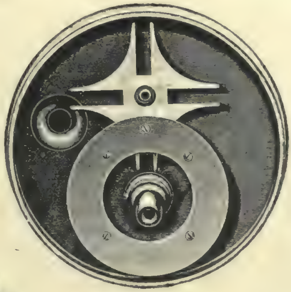


FIG. 96.

FIG. 95. THE TYLER-ERNEMANN PROJECTOR.

qualities. Perhaps some readers may remember that a fire occurred not so long ago at the premises of one of the Cecil Court companies, several of the All Steel Ernemanns, however, coming out practically

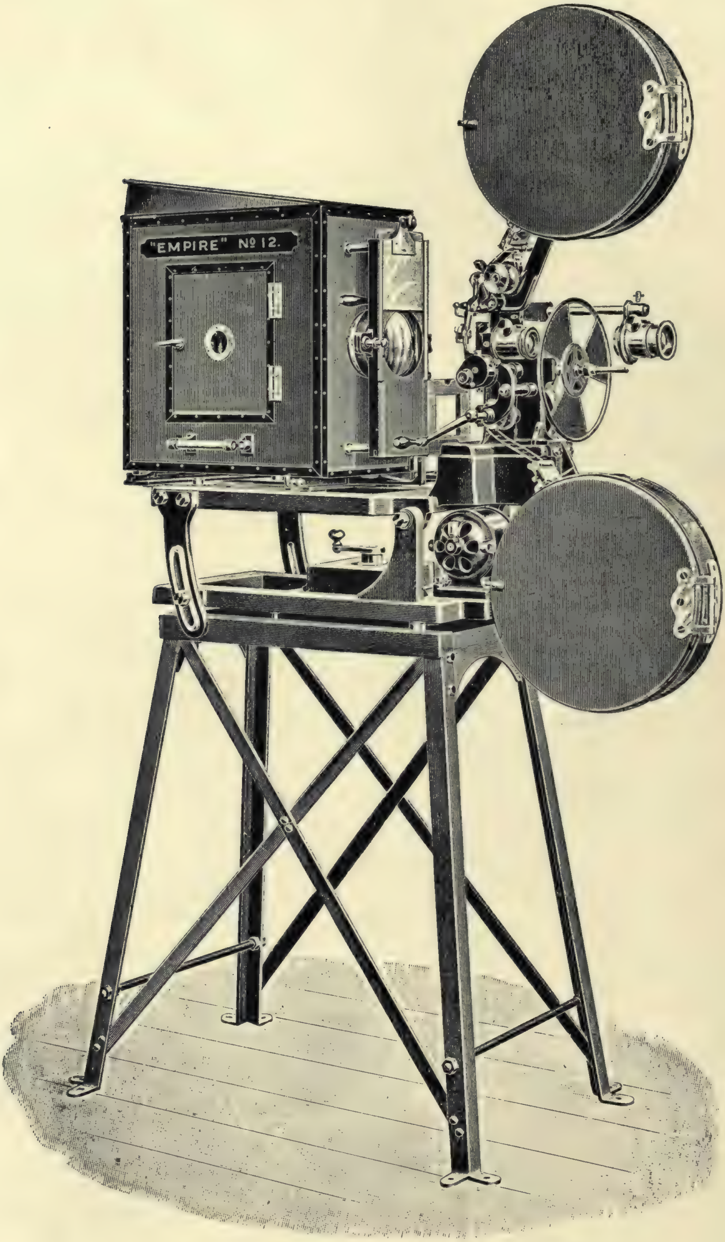


FIG. 97. THE MALTESE CROSS EMPIRE PROJECTOR.

scatheless from the conflagration, due to the high melting point of the materials from which they were made. Another notable point about this same projector is the large size of the Maltese Cross (shown in illustration 96). The same machine also boasts an improved three-bladed flickerless shutter, instantaneously removable condenser glasses, and, in fact, every improvement to be expected or wished for in a motion picture lantern of the highest repute. And with that we have placed ourselves in a somewhat awkward position, for the very next figure (illustration 97) shows a projector not one atom less worthy of unstinted praise. It is the MALTESE CROSS EMPIRE NO. 12 of Messrs. Butcher. Let us be content to say of this machine that it is all it should be, comparing favorably with others and holding its own by virtue of general excellence.

The picture which comes next among our illustrations (fig. 98) will be pretty well self-explanatory to a whole army of kinematograph

FIG. 98. GENERAL VIEW OF THE CHRONO PROJECTOR.

enthusiasts, to say nothing of experienced operators who can scarcely have seen actice service without an introduction to the original of the photo—the GAUMONT CHRONO. No one wants to hear much about the Chrono's essential details now-a-days, for the simple reason that they were familiar to lovers of the best in the art of projection when

other high-class present day machines were still unthought of. It was the Gaumont Chrono which first adopted the flickerless shutter (or so we believe). Certainly it was the firm responsible for the Chrono which first paved the way for the now victorious campaign of quality before cheapness in moving picture projectors. No one who purchases a Chrono expects anything but the best, and we have never heard of any such a one being disappointed.

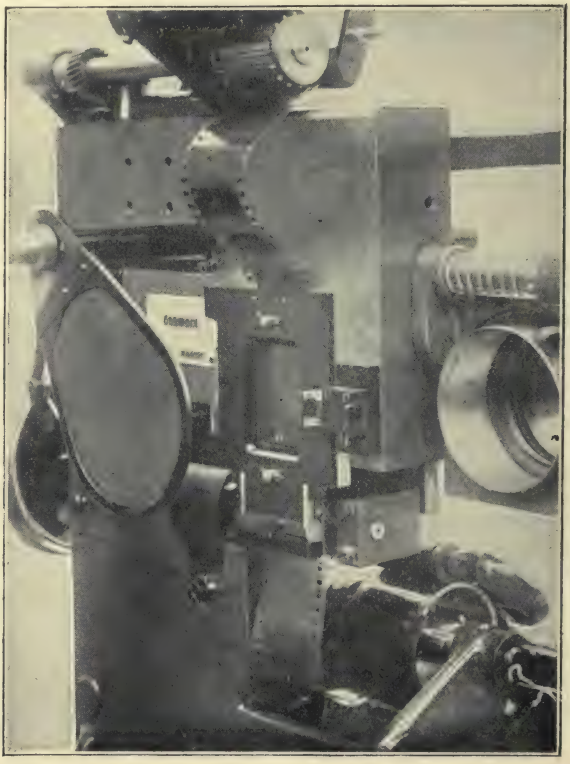


FIG. 99. THE GAUMONT MALTESE CROSS CHRONO, SHOWING ARRANGEMENT OF GATE AND LIGHT SHUTTER.

THE GAUMONT MALTESE CROSS CHRONO has, besides its wonderful reputation, many unique features to recommend it. Moreover, these exclusive features are not mere 'talking points,' or 'selling points,' but actual solid advantages to the buyer and user. For one thing, the cross is so fashioned that the least slackness occurring as the result of wear may be taken up with

the minimum waste of time and trouble by the simple adjustment of two screws. This is, of course, in addition to the cross being bodily removable for replacement, should occasion for this eventually arise. Then again, the new double speed light shutter, as fitted in the Chrono, is so arranged that it travels up and down with the racking of the gate, a matter of great importance in high-class machines, where mask adjustment is effected by means of gate racking, in contradistinction to the employment of a lever-actuated jockey roller. Other good points and special features of the Gaumont machine will be apparent from reference to the illustration block as appended. But no one wishing to hear of this projector's merits need ever trouble over worrying them out from mere printed illustrations and letterpress description. There is not a man of any standing in the kinematograph trade but knows and has handled Gaumont machines, and can tell the novice all about them.

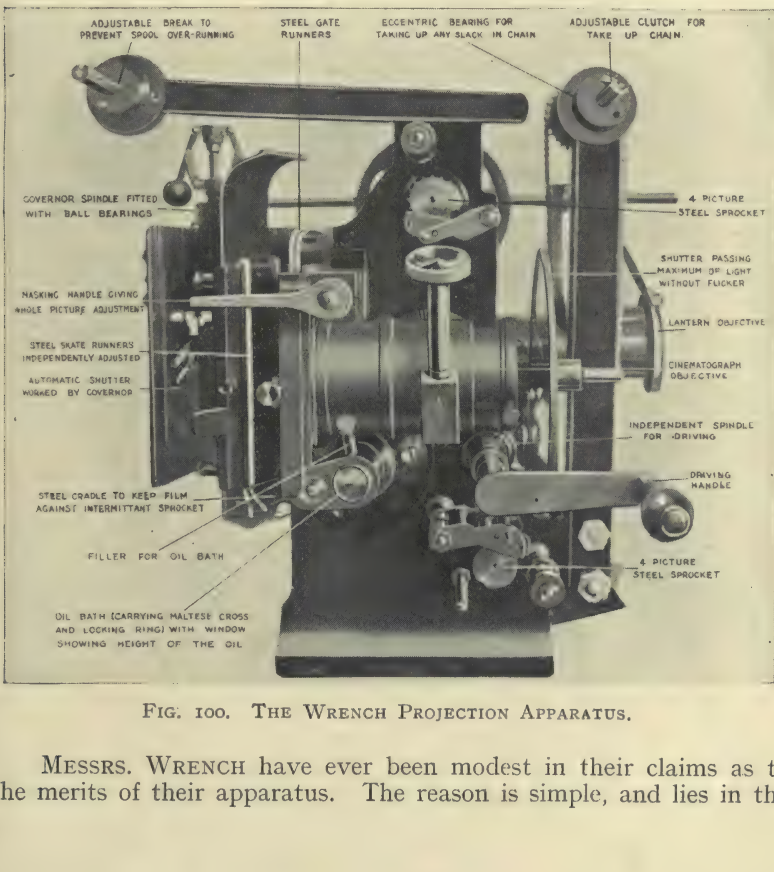


FIG. 100. THE WRENCH PROJECTION APPARATUS.

MESSRS. WRENCH have ever been modest in their claims as to the merits of their apparatus. The reason is simple, and lies in the

fact that Wrench projectors have made for themselves so firm a reputation with the motion picture exhibiting public as to need no superlative epithets of the makers wherewith to label themselves before they go out on the market. We look at the illustration (fig. 100), and ask ourselves if it is not the most convincing thing possible, as setting forth the sterling worth and first-class workmanship of the Wrench Maltese Cross Projector. Note the neat masking lever giving the whole picture adjustment, the hardened steel bearings to all important working parts, the solid steel gate runners, the excellently designed oil bath, the many other advantages plain to see, and it will be agreed the firm of Wrench can afford to go soft in singing their own praises in the assurance that the trade at large will not be slow in supplying the deficiency.

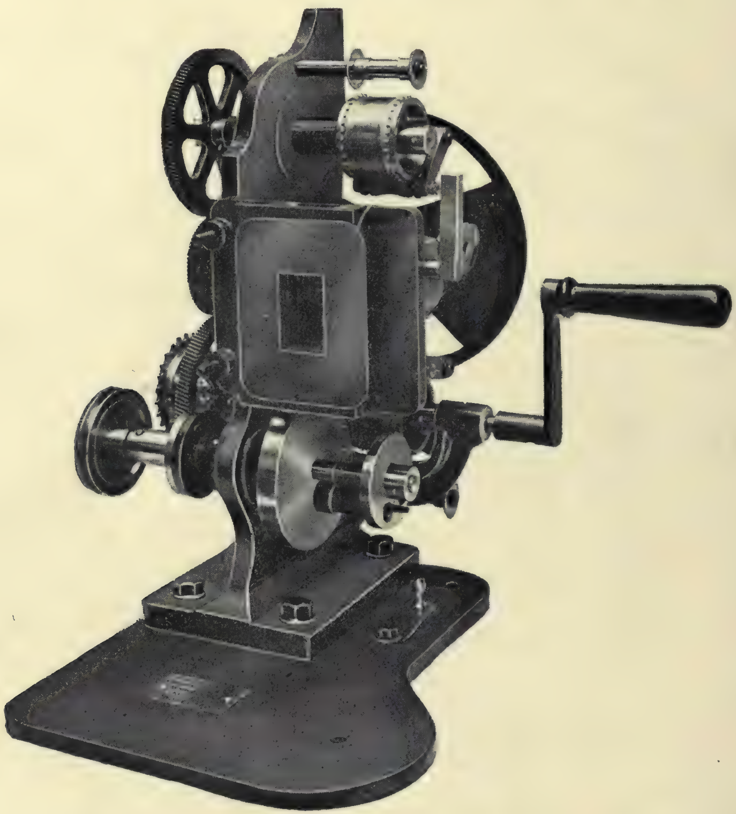


FIG. 101. RUFFELL'S SIMPLE, BUT EFFICIENT PROJECTOR.

We pass on to the consideration of yet another projector, namely, RUFFELL'S BIOSCOPE. It is a machine worthy of a firm whose

name has shone as a light in the kinematograph trade for many a long year—in fact, since the very early days indeed. For that matter, the author had enjoyed more than one display of Ruffell's Pictures before ever he had touched a kinematograph machine in his life. Well, then, Ruffell's Bioscope is just what one would expect under such circumstances. It is a machine of wisdom, of experience, and of a hardy and enduring value. No brilliant yet uncertain experiment awaits the purchaser of a 'Ruffell.' He puts his money on a certainty and may make up his mind to the possession of a machine with a long career of usefulness before it. What more than this need we say? Fig. 101 gives a good idea of this valuable projector.

THE BROCKLISS MOTIOGRAPH.—is the machine with the famed double cone shutter. Really this shutter needs a word or two to itself, since had the Motiograph no other striking point about it, the double cone arrangement for intercepting the light beam during picture change would alone constitute the projector as forming a class of its own. Unfortunately, the Motiograph double shutter is of a form particularly difficult to figure in print. It consists of an arrangement of two pairs of shutter blades, each pair being of 16 degrees and 32 degrees diameter, the whole bent up into a cone shape, and one cone revolving within the other very much after the style of the beaters of a mechanical egg whisk. The complete arrangement is so placed that when the metallic sectors of each cone are nearest to the projector gate, they serve to intercept the light, while when they are at their farthest point of travel, they miss the light beam entirely. Add to this that the two cones revolve in opposite directions, so imparting to the blades a kind of scissors action when opening and closing before the gate, and one has an admittedly vague idea of the absolute novelty of this system of light interception, as compared with that of all other projectors. The Motiograph has, however, beyond its double cone light shutter, a whole host of special and important features, for the mere mention of many of which we have not space at our command. For instance, there is the matter of the phosphor bronze bearings, with their fine adjustments for take up of wear in any part of the machine. Also the film is fed to the gate through a system of spring rollers which prevent side shake in the projected screen picture. Perhaps, though, we cannot do better than use what space remains to us for the purpose of impressing upon the reader the enormous saving of illumination effected by the Motiograph's shutter arrangement. From thirty to forty per cent of light, which would be lost with other machines, is conserved and used in this projector. For lime shows, therefore, the Motiograph should possess an appeal all its own, while the advantage in light saving is well worth considering by showmen employing electricity also. The Motiograph is an American-made instrument, and as such perhaps rather more delicately—that is to say, not quite so solidly constructed as most English showmen are accustomed to. There are many points about this apparatus which must commend themselves to the skilled operator who takes pride in his projection.

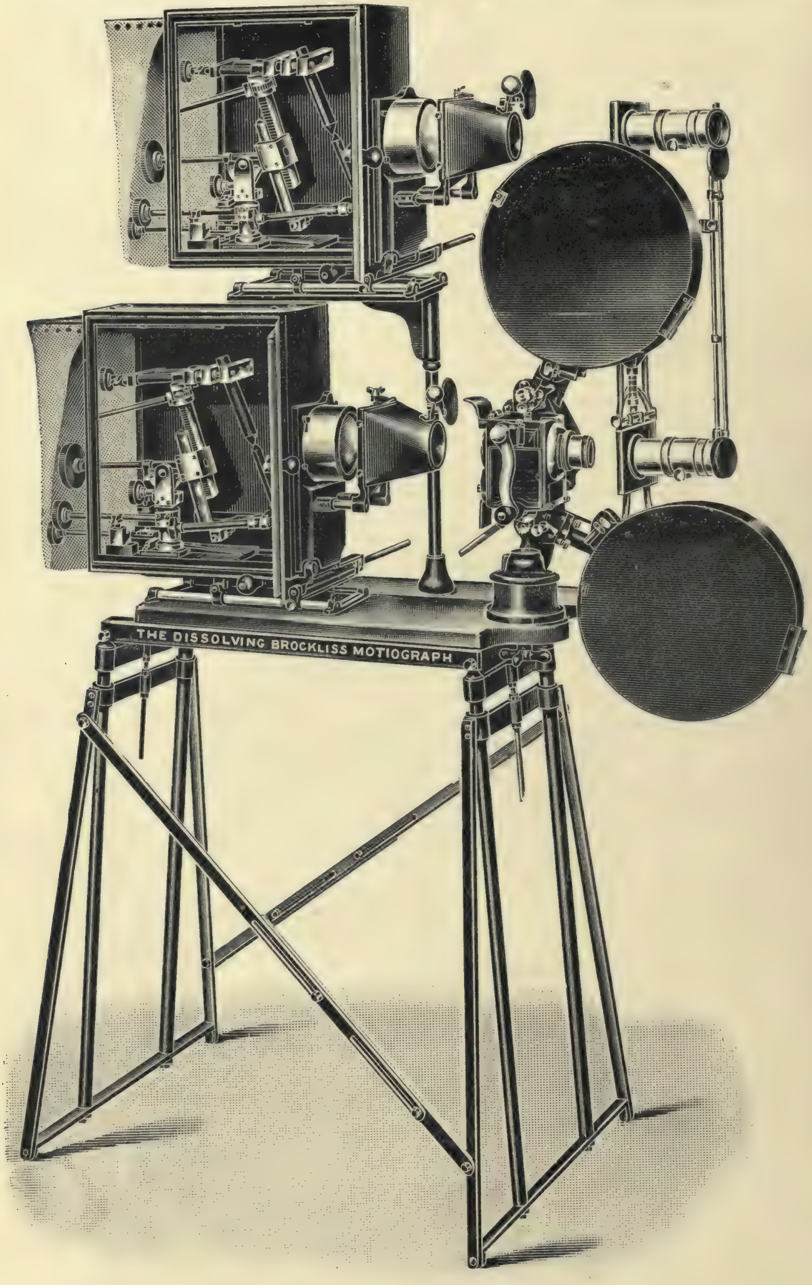


FIG. 102. MOTIOGRAPH.

With the KAMM MALTESE CROSS PROJECTOR (illustration 103), we come up against that very latest type of picture shutter mentioned

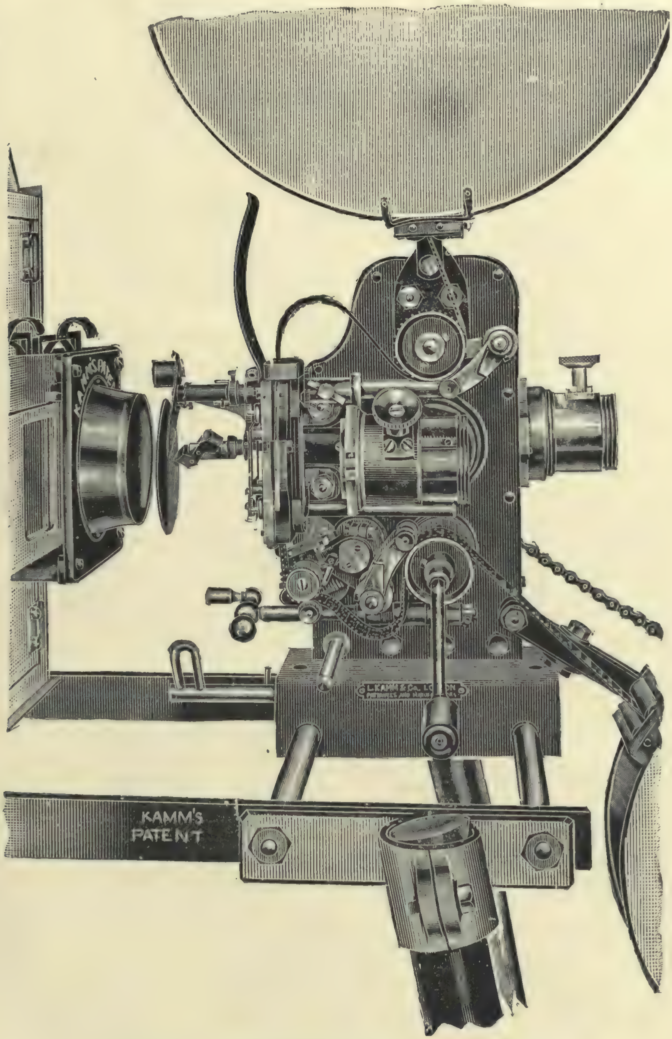


FIG. 103. KAMM'S MALTESE CROSS PROJECTOR.

in the preceding chapter, namely, the double speed light shutter We have already commented upon the marvellous effect of this high speed shutter gearing in the elimination of the last trace of flicker

from the screen, so that here it will be enough to remark that the possession of such a double speed shutter places the Kamm M.C. machine in a class by itself. Other features of the same projector well worthy of note are the oil bath, automatic light cut-off, devised on a specially simple and reliable plan, the heavy fireproof gate, etc.

Another claw system projector is that next figured (fig. 104). This time the mechanism bears the name of that great film house, Messrs. Pathe. All the same, it is worth while noting the Pathe Lumiere Projector is not offered on the market as a tyro's or handle-turner's

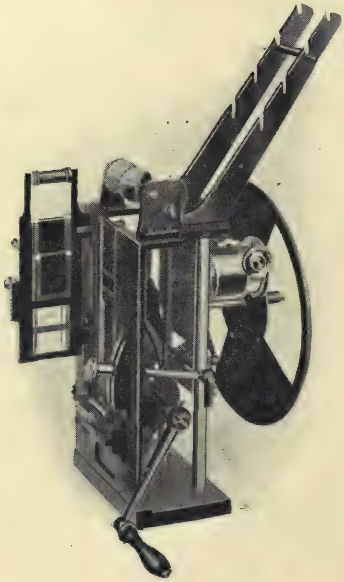


FIG. 104. PATHE LUMIERE.

machine. It is intended to be used only by fully experienced operators and only so must it be expected to develop those marvellous qualities of steadiness and precision which gained for it—and for kinematography in general—the first recognition of the theatrical and entertainment world. For this Lumiere machine in its earliest type was the father of all publicly-exhibited money getting moving picture machines. The regular Pathe projector of the present day is that next shown (fig. 105) known as the 'Pathe No. 2.' It is a specimen of bioscope mechanism of the French type, somewhat lighter in build than we on this side of the Channel are accustomed to. However, the Pathe No. 2 can now be obtained in England in a form of somewhat heavier build and with its parts rather differently arranged, in which guise it takes to itself the name of the 'Pathe Imperial.'

In this and the No. 2 the essential mechanism is the same, to wit, a Maltese Cross running in enclosed oil bath. Such has been found to bring about the happy combination of great steadiness (due to the

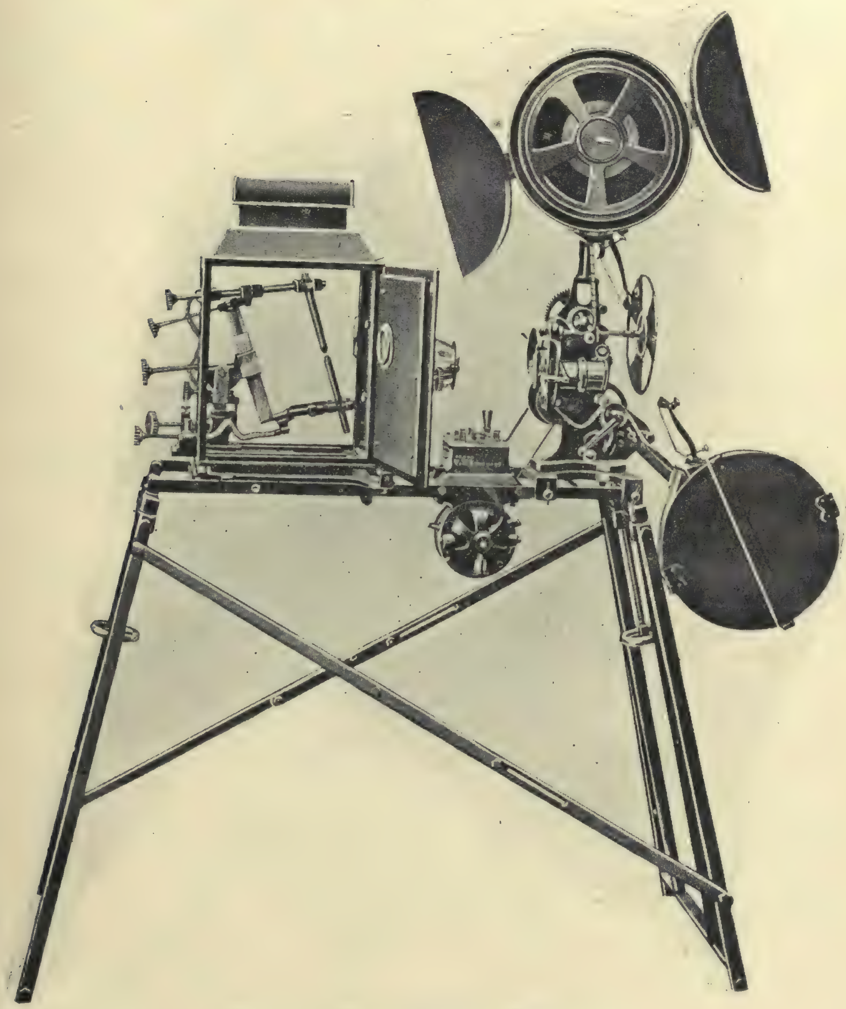


FIG. 105. PATHE IMPERIAL PROJECTOR.

cross) combined with very good wearing qualities (the result of the constant and thorough lubrication afforded by the running of the working parts in oil). Pathe machines of this type are very silent in action.

There is an increasing desire on the part of every Englishman to recognise merit in the effort to produce British productions for the benefit of the community. It is also so in the kinematograph trade ; whether it be film subjects or machines, there is an effort to obtain the all-British production. A successful achievement in this direction is Tyler's British Projector, which has recently been put on the market and has been well christened " Indomitable."

FIG. 106. TYLER'S INDOMITABLE PROJECTOR.

Let us say at once that it does not require a second glance to convince one that Tyler's have struck out for the best, and have attained it. In the build and in the design of the machine there is abundant evidence of the highest mechanical skill and of a determina-

tion at all costs to produce something that shall be solid and thorough in every essential. In these days, when projectors have to stand the daily strain of ten to twelve hours' work, when keen and critical audiences observe at once a badly projected and unsteady picture, and seek their recreation and amusement at halls projecting the best picture, we cannot help feeling that Tyler's will find their efforts to produce a really first-class "All-British" machine, will meet with a gratifying and immediate reward at the hands of the trade.

Among some of the many novel features which must appeal to users are, the heat-proof lantern body, with doors opening on both sides the full extent of the frame ; the stirrup holder for the condenser; the facility for exchanging from kinematograph to still picture lens ; the Maltese Cross movement in its oil bath ; the get-at-ableness of the gate ; the ease with which each part can be adjusted ; the solid bearings and shafts ; the automatic light cut-off ; the sheet steel fireproof boxes ; the original take-up and rewind gear ; the solidity of the projector stand ; the numerous dustproof oil caps, and the general finish and appearance of the whole outfit.

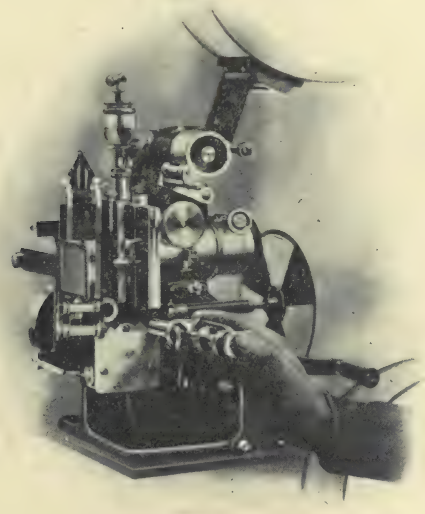


FIG. 106. THE "ZAR" PROJECTOR

Needless to say, many firms are still striving to improve and beat past achievements. Whether any of these efforts will meet with success, it is not for us to hint in a machine review like the present, but the thought of all-steel projectors natur-

ally leads us on to the "ZAR" of Cinema-Halles, Ltd. The Zar machine combines many distinct advantages. The makers claim for it that it combines in itself 'all the best and brightest ideas in projectors to be found both in England and on the Continent.' What we can inform our readers with certainty is, firstly, that it is in every sense of the word a first-class instrument. Passing on to particularise on its merits, we may just spare time to mention its adjustable and removable Maltese cross action, adjustable gate skates, and instantly removable condensers. It is also fitted with a patent flickerless light shutter, an excellent automatic take-up, and a whole heap of other excellent features too numerous to mention here. The price, while not pretending to be low, is moreover very reasonable for an instrument of the sort described. See fig. 106.

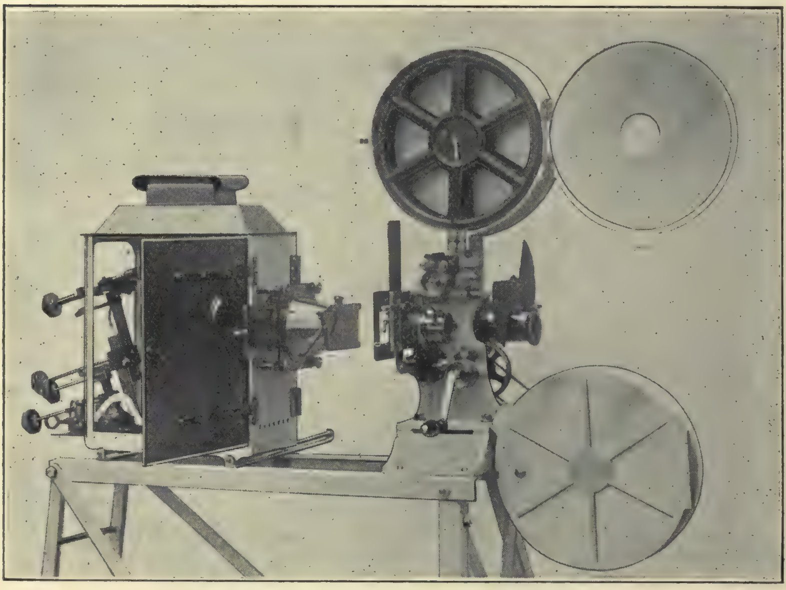


FIG. 107. THE "URBANORA" PROJECTOR.

The URBANORA PROJECTOR is only one of the irreproachable pieces of kinematograph apparatus put out by that standard English firm, the Urban Trading Company. Everyone has heard of the Urban Trading Company, and it is just as great a truism to remark that everyone knows beforehand that if the Urbanora Projector hails from this firm, it is itself a standard of efficiency in projection. The illustration (fig. 107) given herewith, shows in a measure, the smart, elegant and workmanlike design of this projector. A glance will show that

the parts are arranged with special attention to the operator's needs. Thus, the lantern house is splendidly accessible for cleaning purposes, as also the projector movement itself. Of course, the Maltese Cross is of the finest, arranged to be adjustable and balanced to a nicety. Equally the supporting base and stand are at once rigid and reasonably light of construction. Everything, in fact, is as it should be with this particularly perfect projector. We have only to add that the Urban Trading Company is a safe firm to go to for high-class goods of every description in connection with the motion picture business. The Urban cameras (for taking moving pictures) are, for instance, known and appreciated all over the world, and only an unfortunate hitch, which we deeply regret, prevented their getting their due at our hands in the review of picture making machinery in Part I. of this volume.

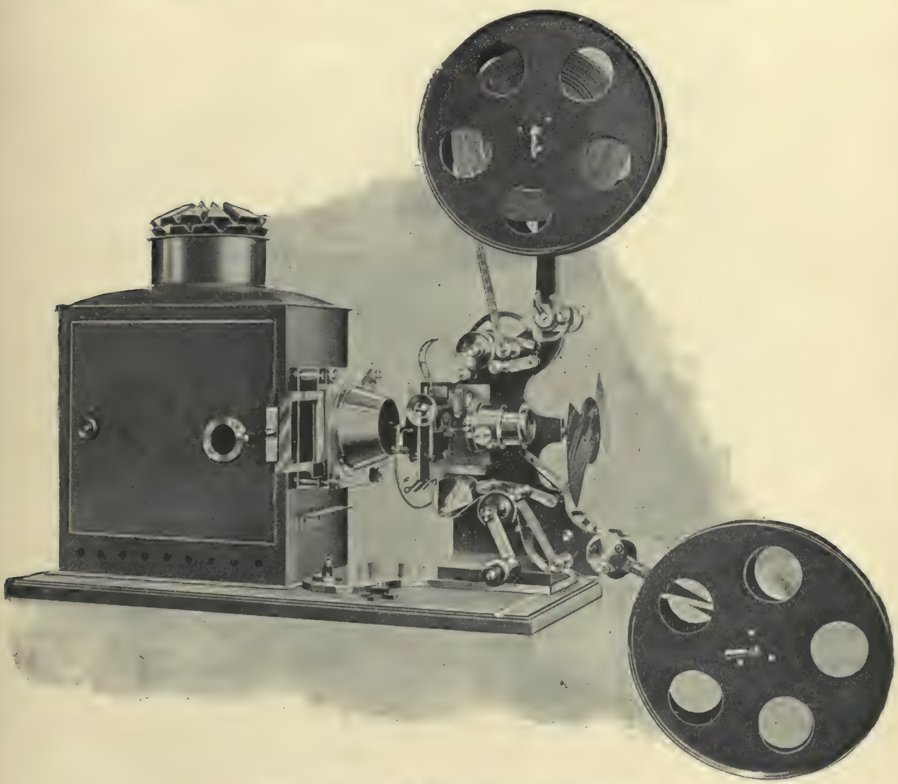


FIG. 108. THE WARWICK PROJECTOR.

WARWICK bioscopes are simply designed machines with little complication of parts, and they possess, as may be divined from this last statement, a consequent enviable measure of durability which

far exceeds that of many a projector of more complex model. Were we operating in any inaccessible part of the globe, such, for instance, as a desert or a country village, we would not hesitate to plump for such a simple machine as the Warwick, in preference to most of the highly expensive and intricate M.C. patterns which now so largely hold the field for cinema and music hall work. The Warwick bioscope is shown in fig. 108.

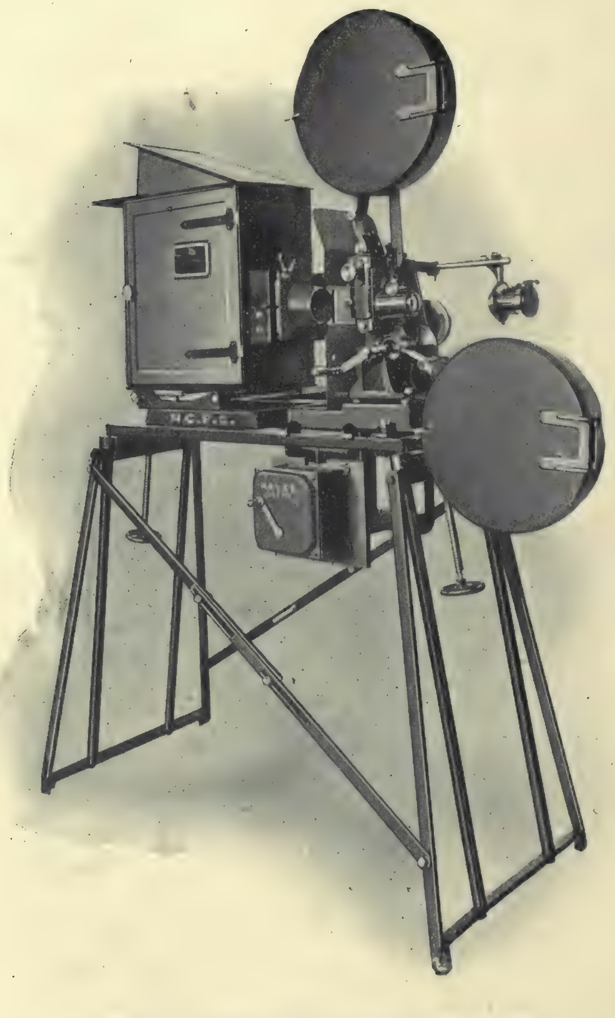


FIG. 109. NEW CENTURY KALEE PROJECTOR.

THE NEW CENTURY KALEE PROJECTOR stands out in the accompanying figure (109) like the Rock of Gibraltar. It is solid, businesslike, and has with it a sort of general air of being invulnerable, which should go far of itself to reassure the intending purchasers of one of these excellent machines. We like the general design, with its firm, amply supported base and clean cut proportions, and what is more, we are sure the motion picture proprietor and operator will like it too. It will be seen, the Kalee projector is of the neat self-contained inside light shutter type, while the Maltese Cross is of generous proportions, by which means wear is minimised and steadiness maintained. Ample gate masking, diagonal cut gears, and a generally sound and scientific design and construction complete a projector which the parent firm may well be proud of.

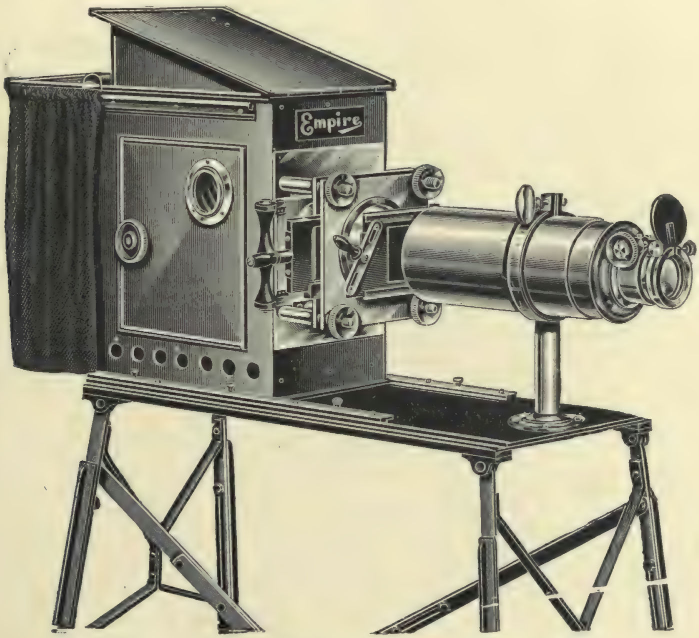


FIG. 110. THE "IRON DUKE" STILL VIEW LANTERN.

The "IRON DUKE" is the appropriate name given to the extremely serviceable still view lantern next figured. The lantern is especially designed for installation in the operating box to relieve the projector of its generally somewhat doubtfully performed function of projecting title and illustrated song slides. That such work should by right be relegated to a distinct lantern is a matter insisted on elsewhere in this volume, and that the one who cares to follow such advice could do

no better than by the installation of an 'Iron Duke' it is impossible to conceive. Not only is this admirable all-metal lantern provided with its own self-contained tilting table, also telescopic three draw front to accommodate lenses of suitable focal length for any picture hall, but it is, in addition to the above, so arranged that it can be utilised as a first-rate 'stage arc' for throwing the well-known spot

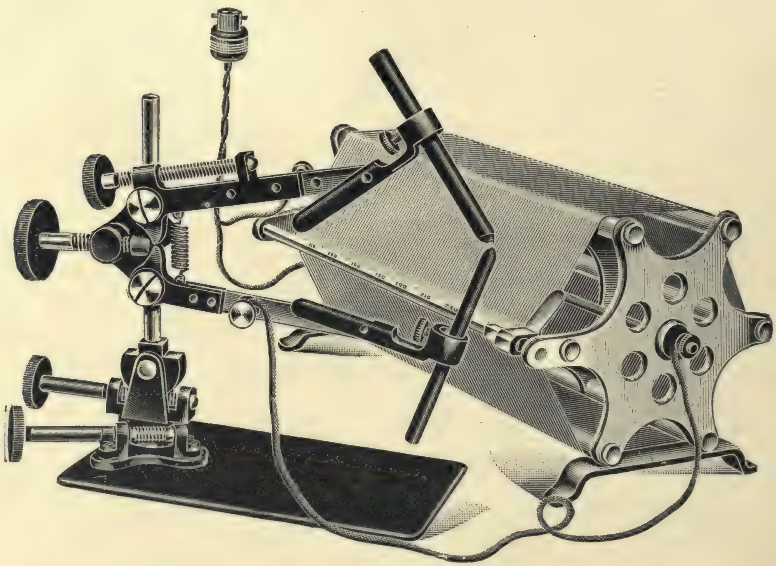


FIG. 111. EMPIRE ARIEL NO. 2 ARC LAMP.

light upon variety turns, now so frequently to be seen at the better class picture halls. A suitable miniature arc for use in the Iron Duke lantern is the 'Empire Ariel No. 2' (illustration 111). The price of the Ariel complete with resistance frame is exceptionally low.

And thus passing from projectors themselves to their attachments, we will yet make pause before what may at first sight look like another maker's machine, though as a matter of fact it is the already mentioned, Pathe No. 2, this time fitted complete with spool boxes and—what is the present object of our attentions—the Mallet patent attachment for automatically sealing the film box apertures in case of film fires. This process is accomplished by two tightly stretched strands of highly inflammable material held directly over the threaded film in its direction of travel out of the upper spool box and into the lower one. These highly inflammable strands hold open substantial sealing shutters hinged over the spool box apertures. Should the film fire in the gate,

and should the fire pass upward or downward toward the film boxes, the flame would be bound to ignite the safety strands, with the instantaneous result that the shutters would be released and fall.

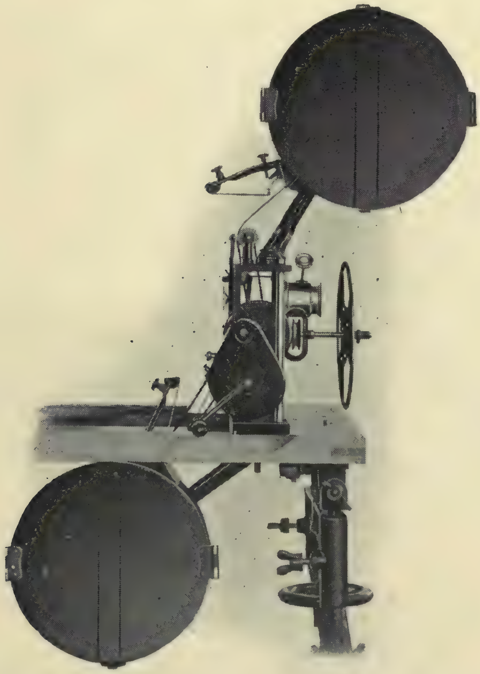


FIG. 112. PATHE NO. 2, WITH MALLET ATTACHMENT.

FIG. 113.
PATHE CONDENSER HOLDER.

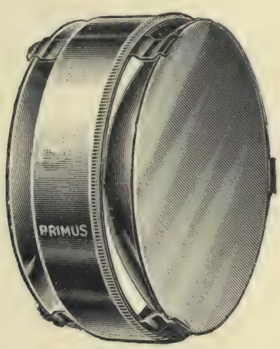


FIG. 114.
BUTCHER'S PRIMUS CONDENSER.

Next (fig. 113), we have a very clearly drawn illustration of a Pathe condenser holder. A glance will serve to show how such a holder with glasses ready set in it, can be taken up in the hand by means of the top handle, and dropped into place in the front of the lamp house almost as soon as a crack in the existing condenser glass is seen. Condenser cracking is, however, to some extent at least, avoidable if due care is taken to provide for the ventilation of the glasses in their cells. Such a well-ventilated cell is shown in fig. 114, illustrating the Primus condenser of Messrs. Butcher. It also has the merit of being as reasonable in price as it is efficient in action.

The Kineto extra heavy condenser (fig. 115) is an example of another highly efficient system of mounting condenser glasses accurately and expeditiously by the employment of a suitably solid trio

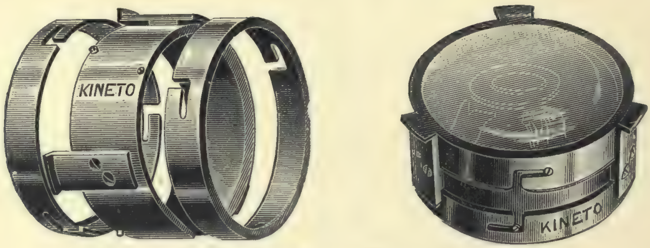


FIG. 115. KINETO'S EXTRA HEAVY CONDENSER.

of tubed rings, which interlock by means of quick-acting bayonet catches. Bayonet catches also hold this extra heavy condenser in the lamp house body, thus allowing of its removal for renewal of a cracked lens in almost no time.

BUSCH PROJECTION LENSES are of three types. First come the ordinary kinematograph lenses put out by this firm. These are listed at a uniform price of 28s. for any focus from two and an eighth to seven and a quarter inches. They are good sound lenses, and the only marvel is that the public still go on paying a guinea or more a time for worthless nameless rubbish in the way of kine lenses, when instruments by a reputable maker are to be had at this moderate figure. Next we come to the Busch Double Illumination projection lenses. Here a new principle is involved, in addition to the general high quality, we get in the cheaper series just alluded to. In these Double Illumination Lenses there is a large gain of effective light on the projection screen, a point which renders them well worthy the especial attention of limelight exhibitors. Still, the price remains extremely moderate, though all the time the quality is of the highest for instruments of the class indicated. But we pass on to the final grade in the Busch scale of excellence. Here price becomes altogether a secondary matter, but our Busch kinematograph lens belongs to this highest plane of excellence, and is indeed a wonderful instrument. Named the 'Glaukar Projection

Lens,' it is, in fact, an instrument of a type so perfect as to be not merely fit for optical projection of the highest class, but also equally suitable for the actual taking of the pictures themselves, and everyone

FIG. 116. THE BUSCH GLAUKAR PROJECTION LENS.

knows that to take a kinematograph picture nothing but the most perfect of optical combinations will serve. In the Glaukar projection lens, then, we have an instrument which may fairly claim to be absolutely and literally perfect. Other makers may equal it. Candidly, we could name at least one English firm of repute which turns out lenses equally as good. But when a thing is perfect, as is this Busch Glaukar, it cannot be surpassed, and there is no getting over it. The block above hardly does justice to its importance and value.

FIG. 117. COURTLANDER'S CINASTIGMAT PROJECTION LENS.

THE CINASTIGMAT manufactured by H. Courtlander is a projection lens specially designed with a view to helping the showman out of the rut of fuzzy indistinct pictures into the clear light of a

good, crisply illuminated projection screen. As such, this lens well merits the attention of those in search of a good thing which is also a product of the old country. Candidly, we wish the Cinastigmat every success, just as we do everything which we judge to be necessary to the abiding welfare of the motion picture industry. If only an

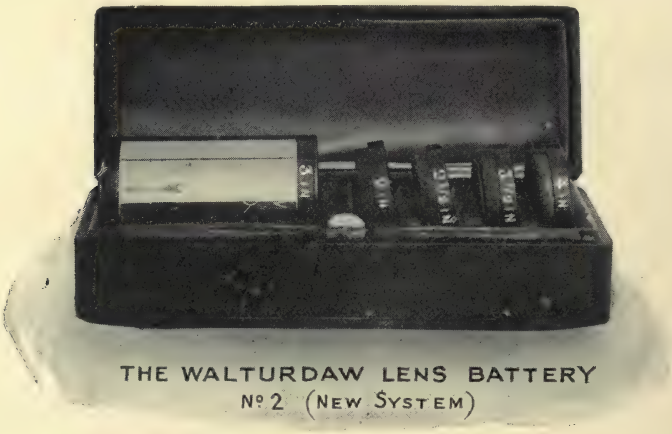


FIG. 118. A CASKET OF PROJECTION LENSES.

earthquake would pitch the whole of the existing inferior kinematograph lenses into the limbo of oblivion, and thus force showmen to replace them with Cinastigmats, a fortnight afterwards there would be no class of people more thankful for the catastrophe than the showmen themselves.

The Walturdaw projection lens battery (fig. 118) will probably prove of service to operators travelling their own apparatus from place to place, and who are constantly being confronted with different conditions of throw when showing pictures. Here the many foci obtainable with such a lens battery will be very welcome.

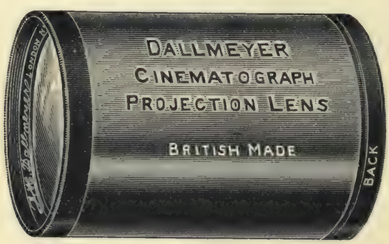


FIG. 119. DALLMEYER PROJECTION LENS.

There can be no question that the man who values clear screen pictures, and who has the interest of the profession at heart, to say

nothing of appreciating largely enhanced returns for small additional outlay, will insist on his projector being fitted with a lens by one of the well-known lens makers, such as Busch or Dallmeyer. The illustration (fig. 119, page 150) is of a Dallmeyer Kinematograph Projection Lens, which may be had in any focus desired from two inch to six inch. Only those who have worked with high-class projection lenses can realise the difference they make to the clearness of the picture, as also their effect in making possible greater economy of current consumption for a given brilliancy of throw.

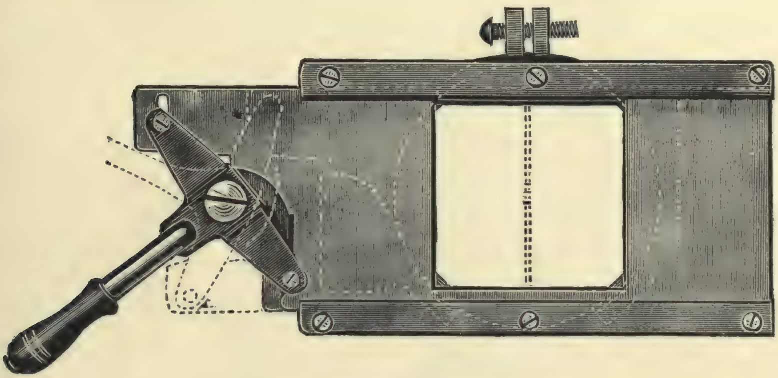


FIG. 120. BEARD'S LIGHT CUT-OFF.

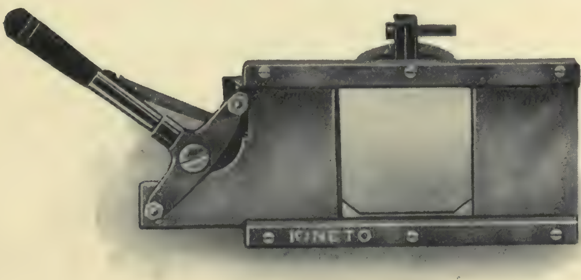


FIG. 121. KINETO LIGHT CUT-OFF.

Figures 120 and 121 show respectively a Beard and a Kineto light cut-off. These cut-offs are of the hand operated type, being therefore auxiliary to the automatic light cut-off fitted to most modern projectors. Hand cut-offs are fitted on the lantern cone, or directly before the slide carrier. In this way they act as curtain cut-offs when projecting title and announcement slides. Both the makes of cut-off figured are practically identical in action.

When speaking of dissolving effects with the electric bi-unial lantern in the chapter on song slides, we made mention of an iris diaphragm to be fitted before the lenses. Such a one is to be found

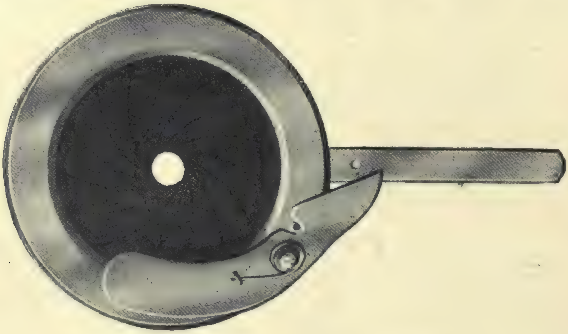


FIG. 122. THE IRIS DIAPHRAGM.

in the 'Cat's Eye' of The Tyler Apparatus Company. We give an illustration in order to make its working clearer. (fig. 122).

Among the firms who from long practical experience, have developed their apparatus to the requirements of the trade, may be men-

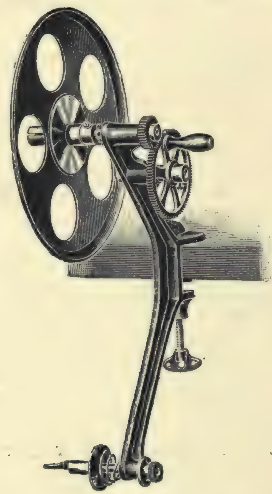


FIG. 123. THE HEPWORTH REWINDER

tioned the Hepworth Manufacturing Company, one of the oldest firms in the trade. They issue what is called the "Heptoic" Bioscope, a good, substantial, steady machine, with every appliance essential to perfect projection. This firm make a feature of complete equip-

ments at an all-round figure—a very useful fact for those who are starting in the profession. They have some unique electric appliances, including the Hepworth Patent Arc Lamp, which, although simple in construction, is effective in its working. Another very excellent adjunct to the operating box is the Hepworth Rewinder, which folds into small compass, and by adding a small sprocket wheel measurement attachment, lengths of film can be duly checked—a matter which pays the cost of the apparatus time and again.

And now we take a jump from the beginnings to, as it were, the very extreme end of projection matters. Hitherto we have been considering how to equip the operating box for the starting of a successful show. But what when films have been shown time after time? It is with heartfelt regret that we have to record the deplorable state of the film selections in certain services which are neither first nor

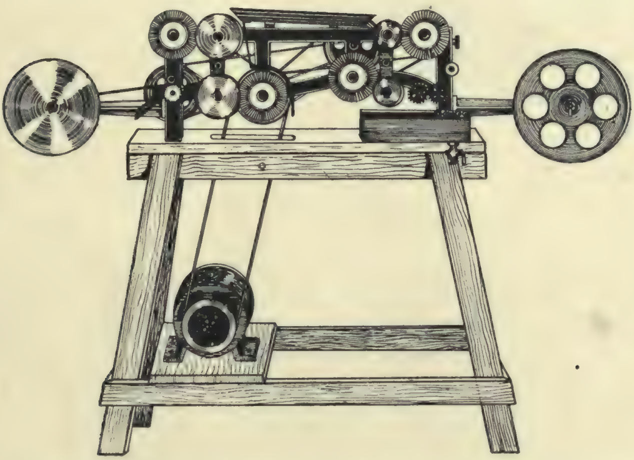


FIG. 124. SEABORNE POWER DRIVEN FILM CLEANING MACHINE.

even tenth run, but where the film is literally shaggy with age, titles gone, endings abrupt, and last, but worst of all, the remainder in a deplorable state of filth and oiliness. The writer has seen film services so far gone in this respect that a run of a few thousand feet only was sufficient to clog the roller of a dog projector almost to the point of sticking. Needless to say, when such film comes into our hands, most of us will have the natural thought "Oh, if only we could clean it before showing." Well, as a matter of fact, this can very easily be done by means of such a film cleaning machine as the Seaborne (fig. 124). In this film cleaner, the work is swiftly and automatically performed in two definite stages. First the dirty film is well covered with a suitable cleansing fluid (be it said a very cheap one), next the

wet film is dried by the train of leather brushes figured in the photo block, by which means dirt and grease are rapidly and thoroughly wiped out, both hillocks and ruts and visible scratches are also wiped out as though they never were. Including the cost of motor drive

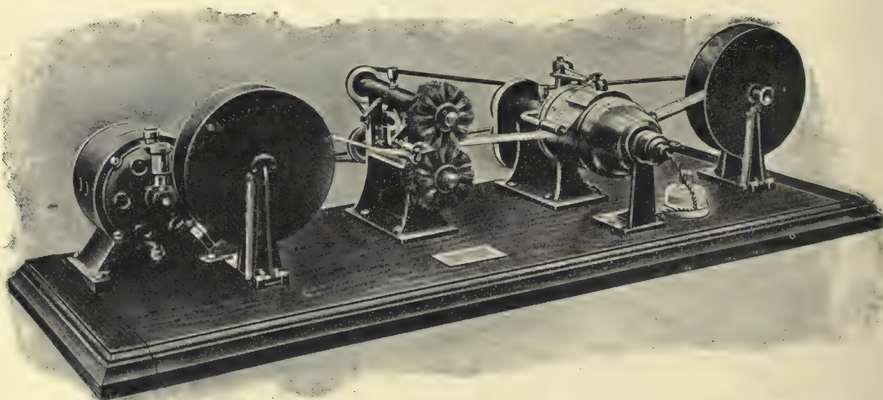


FIG. 125. THE DEBRIE NAMING AND BRUSHING MACHINE.

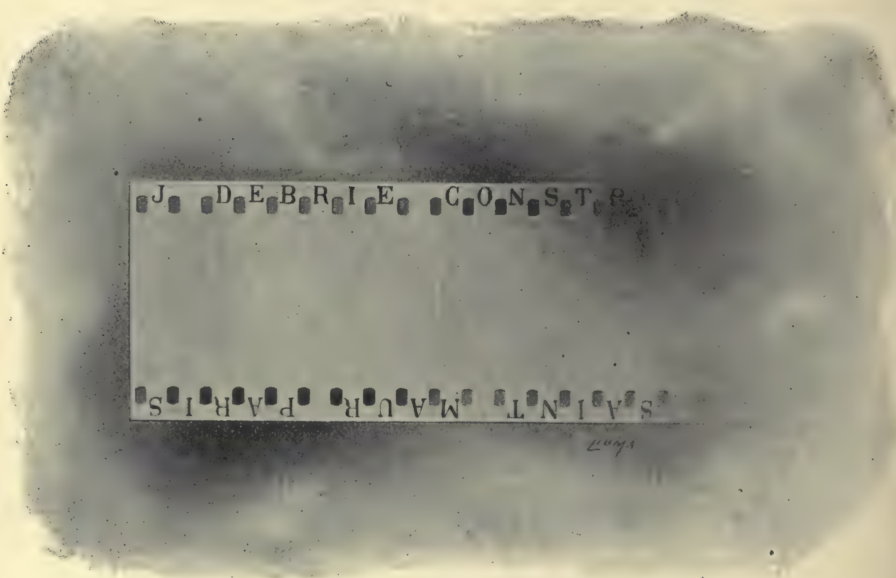


FIG. 126. FILM LETTERED BY THE NAMING MACHINE.

of the Seaborne cleaning machine, the outlay on film cleaning works out at approximately 4½d. per thousand feet, so that even were picture theatres to instal it as an adjunct, the present they would be making the renting houses by cleaning the worst of the film before showing would not be excessive, while for the renting houses themselves film cleaning may now be said to have become an imperative demand. The cost of the Seaborne is not high. That of the Debrie Film Cleaner is considerably more, but then, as has already been explained, the firm of Debrie (English agents, Messrs. Brockliss) makes no bid for cheapness considering only quality in the goods it sends upon the market. A glance will serve to show that the principle utilised for cleaning and wiping the film band in the Debrie and Seaborne machines is very similar. Another ingenious Debrie machine which we mention here for the sake of convenience is the 'Naming and Brushing Machine,' shown (illustration 125). To the operator, the chief interest of this little contrivance will lie in the fact that it is by means of it (or some other similar arrangement) that the maker's name is put on the edge of the positive film he shows. As a matter of fact, the work is accomplished by means of an enclosed incandescent electric light shining through a rotary stencil plate over which the as yet unexposed positive film stock passes after brushing free from dust by the little brush wheels shown in the illustration. Fig. 126 shows how such named film would develop were it placed in the developing bath without intermediate printing behind the usual kinematograph negative by means of a 'printer,' as described in the chapter on Printing (Part I.) By the way, those in search of an inexpensive hand printer may be interested in the concluding illustration (fig. 127). The Walturdaw printer can be had for £18.

To enumerate every projector, arc lamp, resistance, and the hundreds of other adjuncts to the modern operating box now on the market would necessitate a book three or four times the size of the present, we have therefore endeavoured to present a representative selection and have pointed out the characteristics and leading features of each item. Makers of apparatus have seen the value of producing exhaustive and detailed catalogues and lists, fully illustrated and descriptive of their goods. To those about to purchase, therefore, who desire a further knowledge of the respective "points" of the appliances we commend the price lists and also the fact that makers are only too ready to give demonstrations and advice when asked for.

Finally, there is one thing we desire to agitate for, as being a necessity to all well-governed operating rooms, and that is that the iron fire shutter should be of an improved make that can readily be relied upon in all cases of emergency. Among the best we have seen on the market are those with the strong lever releasing gear, which is controlled from both the inside and the outside. Messrs. Jukes, Coulson, Stokes

and Company, of Plaistow, make a big feature of these shutters, which are a real necessity for all up-to-date projection rooms.

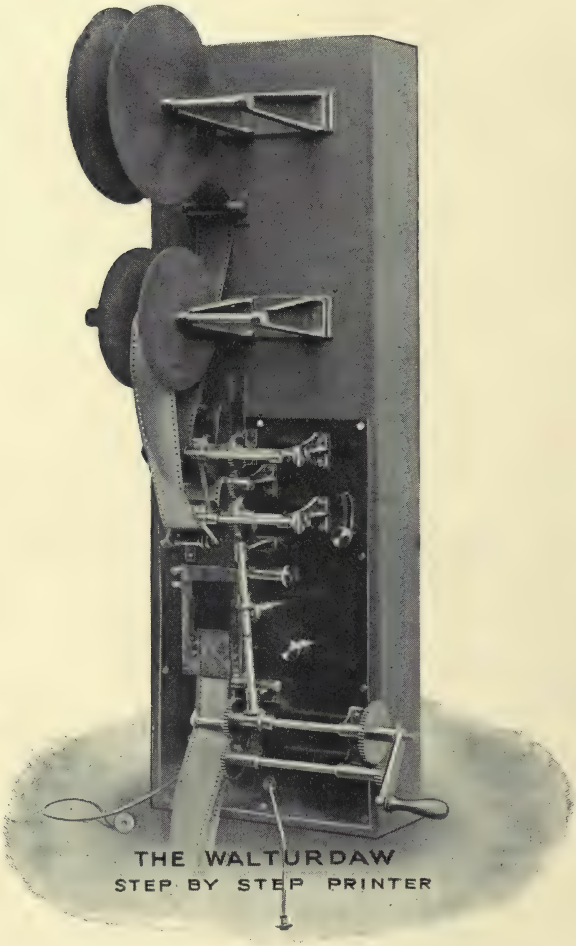


FIG. 127. THE WALTURDAW PRINTER.

CHAPTER IV.

THE ILLUMINANT. ELECTRICITY.

Now to the consideration of the illuminant to use in the projection of moving pictures. Practically speaking, except for amateur work —exhibiting films at home and such like—there are only two alternative forms of illuminant available :—limelight and electricity.

Even here our choice is still further limited by the recent Home Office regulations governing the conditions under which limelight may be employed. Comparing the two forms of illuminant on the grounds of economy and efficiency, there can be no doubt as to the verdict for all serious projection work lying with electricity. As to efficiency, electricity can be made to give an amount of illumination only limited by our expenditure upon current, whereas limelight, apart from every consideration of economy, can never do more than yield a light rather under than over three thousand candle power. Further, the light source with electricity is far smaller than that obtained from the glowing lime, with the result that in the former case the concentration of the pencil upon the projector gate is correspondingly more free from wasteful nebulous edge. Further, electric light for projection purposes is somewhat easier to manage than limelight (both require skilled handling) and on the score of economy may prove anywhere up to ten times as cheap in use, especially where the kinematograph show is remote from the nearest centre for gas cylinder charging, and where electric current is produced on the spot by means of a good class private generating plant.

For the foregoing reasons, electricity claims first place in our description of kinematograph illuminants. We will start upon its manner of employment in the projection arc by giving a brief sketch of its generation and measurement, also some of the most important terms of nomenclature.

Electricity, or electric current, as it may be called, can be generated in various ways. Moreover, the manifestation of it is often vastly different according to how it is called into being. For instance, lightning and the commodity which produces rotation in an electric motor are both electricity, and the only reason for the vastly different phenomena connected with the two manifestations of electrical energy is to be found in the manner of the current's generation.

The form of electricity which alone comes into evidence as the electrical supply of a picture hall is a continual " flow " or " current " manufactured by means of a machine called a dynamo or generator.

Such a generator consists of a soft iron drum wound about with coil upon coil of insulated copper wire and made to rotate at very high speed within the field of a powerful magnet. This rotating

drum of wire is called the armature. The result of such a strange arrangement is that currents or waves of electricity are caused to form in the whirling wire coils, and this electric current is duly led to a circular arrangement of metallic conductors called a commutator, upon which press 'brushes' usually consisting of blocks of carbon. These collect the current and take it to binding screws or lugs, and from them wires known as 'main leads' further convey the electrical energy on its mission of usefulness.

Sometimes this mission is directly to supply light for the projection arc and the small incandescent lights of the picture hall. Sometimes, on the other hand, the main leads take the current to a series of glass boxes filled with weak sulphuric acid and containing lead plates covered with a paste of lead oxide. These are known as accumulators or secondary storage batteries.

When they are in use, the current in its passage through the acid and the lead plates converts the paste on the latter into a very unstable form of metallic lead. The accumulator is then said to be 'charged,' for it now has in its turn conferred upon it the property of giving out electricity from its terminals in an amount dependent upon the size of the plates and charging they have received.

Thus, we already see that besides electricity being generated as the result of purely mechanical action, it may also be given off in connection with chemical action. It is more usual, however, to take the current direct off the dynamo or generator for supplying the projection arc.

Electricity as produced for picture work has a voltage of anything from 60 to 500, the latter being very high for the work intended, and about the greatest potential to be met with in practice. This word 'voltage' will be explained a little later, together with other electrical terms. In any case, current of the voltage to be met with in picture halls only flows well through metal leads, preferably copper. Where the current is required it is accordingly led by the simple means of connecting a copper wire of suitable diameter (according to the amount of electricity wanted in any particular place) with one terminal of the electrical generator, and bringing the electrical flow back along a second copper wire to the other terminal of the generator. The current is thus supplied with a loop of wire along which it may run out from one terminal (the positive) and back again to the second terminal (the negative). Break this loop by cutting the wire at any point and the current refuses to leap the gap—unless it is a particularly short one.

That last simple fact is utilised in practice as the means of checking electrical flow when not required. The adaptation of the idea takes the form of the electrical switch.

A switch is merely a hinged metallic prong which can be made to grip firmly between conveniently situated metallic jaws, or to fly out of contact with them at will. The prong and the jaws into which it fits form part of the 'circuit' or electrical loop of wire to and from the

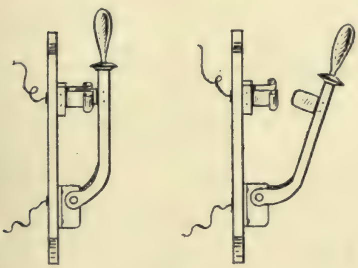


FIG. 128.

generator. When the prong is in the jaws of the switch contact current can flow along an unbroken metallic path. Pull the prong out and the track is interrupted. Fig. 128.

Beside providing a copper track for elecricity to run round, there is another matter which is to be attended to in order that the current, especially current of the higher potentials, may be employed in safety. This is to see that the conducting circuit is surrounded by substances through which the current has a particular objection to flowing—otherwise called non-conductors of electricity.

Non-conductors are non-metallic substances such as india-rubber, manilla, oiled cotton, silk, vulcanized rubber, paper, etc. Electric wires are insulated with such substances to make them safe to handle while 'alive,' or carrying electricity, also to prevent current from running to waste through chance metallic side tracks. Damp surfaces are also partial conductors of electricity, and where a bare wire comes against such some of the current has a habit of trickling down into the ground below our feet and disappearing. This is known as an 'earth.' Where there is a doubt that electricity bills are unduly high, 'earths' or 'grounds' should be tested for by the electrician' using an insulation tester known as an 'ohmmeter and generator,' or 'megger.'

Below will be found diagrammatic illustration of a direct and alternating current electric generator. The most fundamental difference between them is that whereas in the direct current generator or dynamo the commutator is segmented, in the alternator the commutator is of the 'split ring' type.

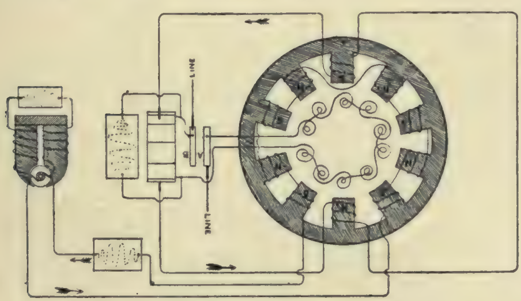


FIG. 129. DIRECT AND ALTERNATING GENERATOR COUPLED.

If, instead of driving a dynamo by means of mechanical power, electric current is sent through its windings in the opposite direction to which it would be given out in the usual way, the armature rotates of itself as a consequence. Thus, we may either use such an electromagnetic machine to make electricity (for which purpose the armature is turned mechanically by say a steam, gas, or petrol engine), or we may use it as a source of mechanical energy by turning electricity into its coils.

Electro-magnetic machines specially adapted to give power in the shape of rotation in response to feeding with electric current are termed 'motors.' Small motors of one-eighth horse power or less are now commonly used in the operating box to turn the mechanism of the projector, instead of the operator doing it by hand. These small motors consume little more current than an ordinary sixteen candle carbon filament lamp.

Now to turn to electrical nomenclature.

Direct and Alternating Current (D.C. and A.C.)

The electric 'current,' as it is termed (the word is not in any sense explanatory, and an attempt to give here the modern theory as to what electricity actually is would be productive of no practical good) this electric 'current' is generated of two kinds, direct and alternating. Direct current flows in a constant stream from the positive to the negative pole of the generating system, and that is all there is to say about it, but alternating current may be looked upon as a succession of electrical waves going in opposite directions. Each wave pulses through the circuit in an almost infinitely short space of time, dies down, and is succeeded in the fractional part of a second, by another one going contrarywise to the last. Thus, with the alternating kind of electricity there is really no positive and no negative pole, since both terminals of the generator become alternately positive and negative at intervals of anywhere between the twenty-fifth and the one hundredth part of a second. The sum of alternations of direction of current flow per second is spoken of as the 'periodicity' or number of 'cycles' of the alternator producing it. Thus, a fifty cycle system would be produced by a fifty cycle alternator. All this means that with the particular description of alternating current in use, the direction of flow alters fifty times in each direction with each second of time.

Note that whereas either direct or alternating current may be produced by an electrical generator according to the system of 'commutation,' or current collection employed, storage battery systems give only direct current. Also, systems involving auxiliary storage batteries for use in case of temporary breakdown of machinery are invariably of the direct current type. In stamping the descriptive plates to be affixed on electrical machinery, and otherwise in the notation of electrical energy, a straight line stands to denote direct and a curved one, alternating current.

In kinematograph projection, employ direct current whenever possible. It is more economical than alternating when used for the projection arc. Further, the arc's crater, on which it will subsequently be found the performance of the arc depends, is formed much more satisfactorily and is much steadier when direct than when alternating current is employed. Also, where the kinematograph is to be

electrically driven, this can be far more satisfactorily accomplished by means of a direct than with an alternating motor. The latter class has a very bad efficiency at starting under load, the best small power alternating motors being those of the 'repulsion' type.

Having now tried to sketch the chief practical differences between the two great systems of electrical supply, we will go on to define terms common to both. Instead of putting the formal definitions first, however, we will, if you please, work up to them in our own way.

VOLT.—The Volt is the electrical unit of pressure, just as the pound to the square inch is the unit of steam pressure. The word 'volt' does not indicate quantity of electricity in the least. For instance, there might be the equivalent of a horse power of electrical energy passing through a conductor at a pressure of say ten or even five volts while the next conductor might carry a tenth or even a hundredth the amount of current at a pressure of 10,000 volts. The term for quantity in electrical parlance is 'ampere,' commonly shortened into the familiar contraction 'amp.'

AMPERE.—An Ampere signifies a definite amount of electrical energy, the actual amount of work to which it is equivalent being decided by its pressure in volts, and the time for which such current flows. And this brings us to the consideration of our third important electrical unit, the one which corresponds to friction as met with in estimating ordinary mechanical energy. We all know that when a machine is doing work, mechanical power is absorbed by the combination of gravity and friction, which tends to stop the rotation of the wheels and mechanism generally of the machine.

These electrical terms may be compared to the action of a man pushing a truck along a road. The man presses the handle of the truck (this is the voltage), he overcomes the friction (the resistance) of the wheels on the axle and against the surface of the road, etc., and the truck moves. The rate at which the truck moves is equivalent to the electric current. The more the man pushes (viz., the greater the voltage or pressure) the greater is the movement of the truck, which corresponds to the greater flow of current which would accrue from an increased voltage. If, on the other hand, he suddenly wheels his truck off wood pavement on to a rough gravel path, then the same pressure will only allow a slow speed, and to get the same speed as when on wood pavement he has to exert himself more. That is to say, the greater the resistance, the greater is the pressure or voltage required to get the same current of electricity. Electricity in itself is practically useless. It is the *flow*—the electric current—which is of value.

In electricity the flow of current along even the best conductor is attended with the necessity for similar driving power to send the current on its way. It is this driving of the current that calls for the pressure—otherwise voltage—in an electrical circuit. The voltage expends itself against the circuit's resistance—the equivalent of mechanical friction—only that amount of 'amperes' of current travelling through the circuit which the voltage is sufficient to drive. Thus the third electrical measurement to be taken into consideration is the internal resistance of the circuit. This resistance is measured in 'ohms.'

The OHM is the unit of electrical resistance. It is that resistance to the current which is exercised by a column of mercury one square millimetre in section and 106.3 centimetres in height. That gives us our first *tangible* electrical measurement, and from it the volt and ampere become also tangible electrical units, for :—

ONE VOLT is that electrical pressure which is required to cause ONE AMPERE to flow through the resistance of ONE OHM.

The actual pressure corresponding to one volt has been originally decided by calibration with a standard type of electrical primary cell. It is also possible to state the actual equivalent in horse power of an amount of electrical energy, and this is done in terms of ' wattage.' Thus :—

ONE WATT is the energy represented by one ampere at a pressure of one volt. Seven hundred and forty-six watts is the equivalent of one electrical horse power, so that it becomes comparatively easy to work out the equivalent in horse power of any dynamo — which we shall remember is the name given to the machine used to produce electrical energy. For instance, take the case of a five kilowatt dynamo. This will give an electrical output of five thousand watts, one kilowatt equalling a thousand watts. Divide 5,000 by 746 and we shall find the electrical output of the dynamo to be the equivalent of 6 7-10 horse power (aprox.)

We cannot pass on to other considerations without setting forth Ohm's Law :

OHM'S LAW :—Current equals pressure divided by resistance. Let C stand for current, E for pressure (electromotive force), and R for resistance, then setting down Ohm's law as a simple algebraic equation—

$$C = \frac{E}{R}$$

The above simple formula is of endless use to the electrician. By the aid of it, he can ascertain for himself either the current, voltage, or resistance of any given circuit where the other two electrical quantities are known. Thus by simple means of algebra we see that if

(1) $C = \frac{E}{R}$ it must also follow that

(2) $R = \frac{E}{C}$ as also that

(3) $E = C \times R$.

As an example of the use of the above formulae derived from Ohm's law, suppose the voltage of a given circuit is not known, but the amperage and resistance are, then, from formula (3), multiplying the two latter together will give the required potential.

Perhaps the simplest of all forms of stating Ohm's Law is by means of the 'rule of thumb.' Here it is :

$$\frac{V}{O \quad A}$$

V here means, of course, voltage, A amperage, and O resistance. The rule is when wishing to find out the third unknown quantity where two are given, cover up the letter representing the unknown and proceed to divide or multiply the amounts represented by the two remaining letters according as to whether they show themselves on the same side or on opposite sides of the line. The result is precisely the same as when Ohm's Law is worked intelligently and takes the same amount of trouble, only the rule of thumb seems on the surface to call for less intellectual effort, and will doubtless therefore be appreciated.

Electrical Units of the Electricity Supply Corporations

The electrical unit used when computing the charge for electrica service is the watt-hour, or rather, the amount of electrical work represented by 1,000 watt-hours. The watt-hour is just the thing it calls itself : the service of one watt of electrical energy for the space of one hour, or of a correspondingly larger or smaller amount of energy for an equivalent shorter or longer time. Two watts running for half an hour would thus be one watt-hour. Also, the twentieth part of a watt running for twenty hours would be one watt-hour. The reason for making the practical commercial unit one thousand times the watt hour is purely a matter of convenience. This thousand watt-hour electrical quantity is known as the Board of Trade unit—familiarly the 'unit' or 'B.T.U.' A unit of electricity may cost anything from one penny to eightpence when bought off the public supply. When generated by means of a suitable private plant, a unit may cost the producer scarcely more than a halfpenny, according to how generated. The unit will be seen to be the equivalent of about one and a quarter electrical horse-power for the space of one hour. Also, taking the voltage of the projection arc at 70, one unit of electricity would provide about 14 amperes for one hour. In other words, a 40 amp. projection arc will consume about three units of electricity per hour. We are here well up against the important item of running costs of projection. Accordingly, it may not be out of place to note that supposing the arc is on for three hours and the electricity rate fourpence per unit, the cost of current (exclusive of upkeep of carbons, etc.,) would be 3s. This gives a fair idea as to what electricity charges would be where town electric supply is in use. Later on, it is hoped to indicate methods of obtaining one's own electrical energy in more economical fashion. This talk of quantities and cost of current brings us to the consideration of electrical measuring instruments.

The instruments necessary on every well-equipped switchboard are an ammeter and a voltmeter.

An AMPERE METER, often abbreviated to 'Ammeter,' depends for its action on the fact that a coil of wire carrying current is magnetic and will attract an iron core, the amount of attraction being proportional to the number of amperes applied. Current to be measured by this instrument is made to flow through the windings, and the movement of the core is then indicated on a dial by a pointer attached to it.

A VOLTMETER is an instrument for measuring the voltage or electric pressure between any two points of an electric system or circuit. The usual form of voltmeter for practical work is a core or coil arrangement similar to that of an ordinary ampere meter, in which the movement of the core depends on the magnetic pull of the coil. The amount of this pull, in its turn, is governed by the number of turns of wire in the coil, and the strength of current running through same. By reference to Ohm's Law it will be seen that the voltage of an electric current is dependent on the resistance of the circuit, and the number

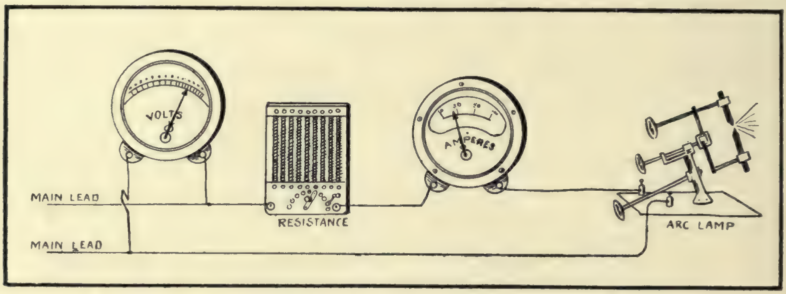


FIG. 130. VOLTMETER AND AMMETER CONNECTED UP.

of amperes flowing. Accordingly, where the resistance is kept constant the current will depend on the voltage applied. The movement of a voltmeter's core depends therefore on the amount of current in the instrument, and the deflection so produced will record the voltage of the circuit. The resistance of a voltmeter is usually very high in order that the current absorbed may be negligable, and therefore very many turns of fine wire are necessary. For this reason it is very easy to burn out a voltmeter by over-running. Fig. 130 shows the method of connecting voltmeter and ammeter with the necessary wires. Technically, the ammeter would be said to be connected in series, and the voltmeter in parallel.

THE PROJECTION ARC.

The projection arc lamp on which the bioscope depends for its source of illumination is a heavily made instrument of the hand-feed type. The electric arc lamp consists essentially of two carbon points or rods, one of them being connected with the positive and one with the negative cable of the electrical circuit. If current of more than 40 volts potential be turned on and the carbons momentarily 'struck,' or brought together and then as quickly parted again, the electricity

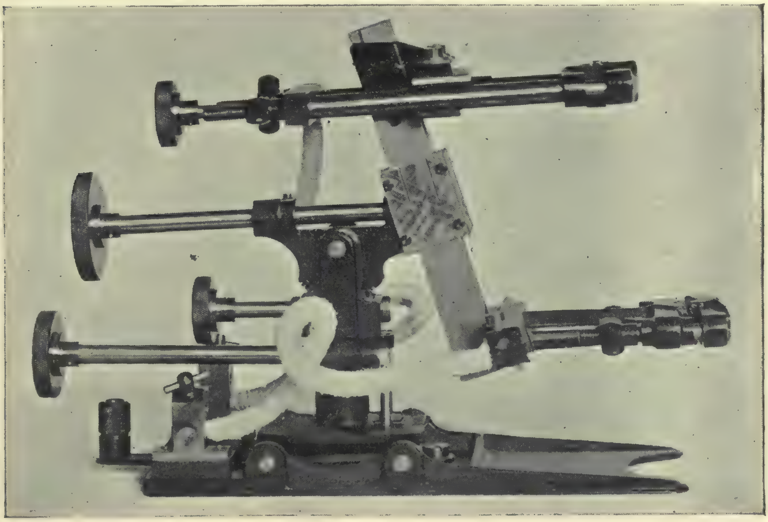


FIG. 131. DIRECT CURRENT ARC SHOWING ANGULAR TILT TO BRACKET.

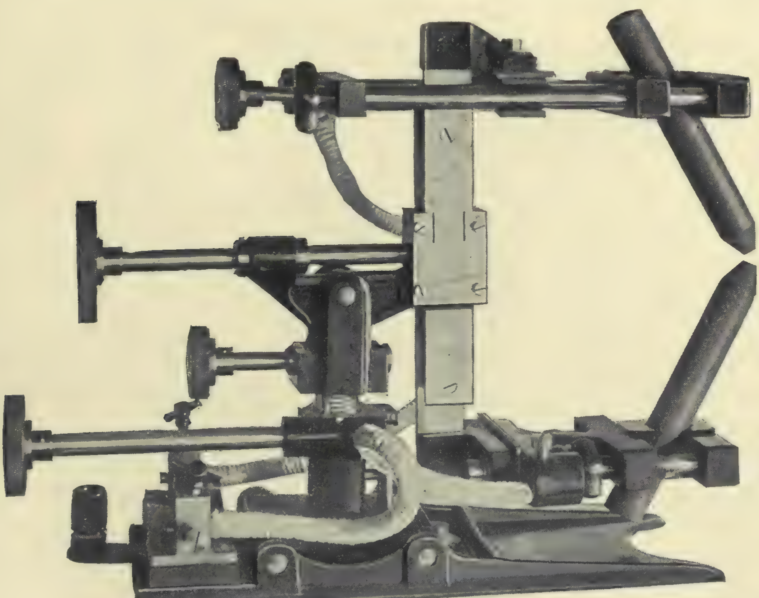
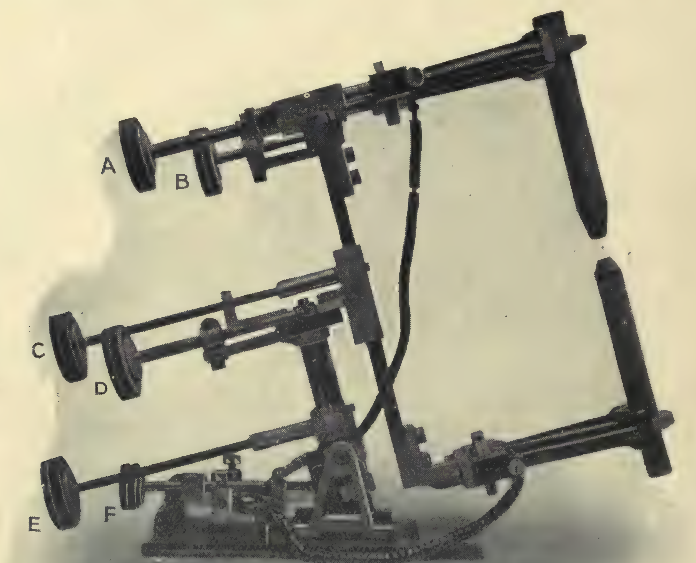


FIG. 132. ALTERNATING CURRENT ARC SHOWING VERTICAL BRACKET.

will be caused to jump from one carbon to another over a short air gap. Incidentally, the positive carbon will become incandescent, the amount of light given off by it depending upon its size and the quantity of current flowing. While the light continues the carbon is burning away from both rods, though chiefly from the positive one. The positive being made of larger diameter, burns short at the same rate as the negative and so keeps the arc at a constant position when the carbons are fed together. All the same, the air gap gradually widens till it becomes so great as to put the arc out. To cause the arc to remain burning therefore, some device is necessary whereby the carbon rods can be 'fed' together as they are consumed. Further, to ensure keeping the position of the arc's 'crater' upon the positive pole (from which the major portion of the light emanates) exactly at the focus of the condenser, a second movement is necessary to the arc feed whereby the two carbons may be raised and lowered together as a whole. We must bear in mind when dealing with D.C. arcs that the crater when properly formed occupies a slope of about 45 degrees upon the end of the positive carbon, while the light from it is thrown, not straight ahead, but partially downwards. Therefore, to get it through the condenser lens, the entire bracket holding the carbons has to be tilted backward about 25 degrees.



THE WALTURDAW
ACME ARC LAMP

FIG. 133.

The Walturdaw Acme Arc is a lamp of the latest and most approved pattern, being fitted with every possible movement. See the six insulated milled heads. (Fig. 133.)

The subjoined illustrations of practical hand-feed arc lamps show the various movements referred to and how they are accomplished by means of insulated milled (handles) heads. It is significant that while from time to time automatic feed projection arcs have been placed on the market, they have made no headway. In truth, the crater adjustments necessary for maintaining a steady light of high efficiency on the gate of the projector are of so delicate a description as to defy mere mechanical means of regulation.

With alternating current arcs other conditions are met. Here, since both carbons are as much positive as negative they both burn away at the same rate, also, there is a crater on each. The light given

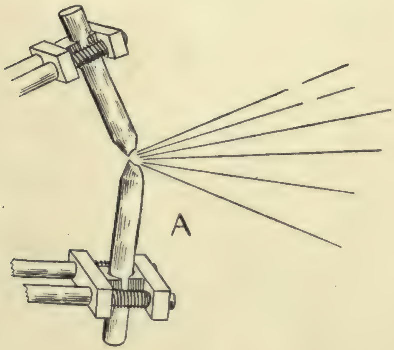


FIG. 134. "SCISSORS" SETTING OF CARBONS.

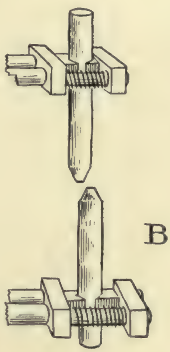


FIG. 135. ANOTHER SETTING OF CARBONS.

off travels straight out at right angles to the carbon set. Fig. 134 gives the older arrangement for setting carbons when using alternating current. It is known as the 'scissors' arrangement. While giving a good light efficiency this set has of later years been more or less surplanted by the one shown in fig 135, the latter set being, in fact, practically identical with the D.C. method, except that the backward tilt of the bracket carrying the carbon feed arms is absent. The latter set, while not giving so great a light efficiency as the scissors, has the advantage that the crater, when formed, keeps its shape far better. It will be noticed that with the direct current set either as used for actual direct or for alternating supply, an essential point, is that the lower carbon shall be somewhat advanced in relation to the upper one. This forward position of the lower carbon determines the form of crater obtained, and the skill of the operator in managing the projector illuminant is very largely shown by his ability to keep the crater right through the medium of such adjustment. Where the current is alternating, the

carbons used in the lamp are both of one size (fig. 134 and 135), and both 'cored,' that is to say having a core or stuffing of soft carbon pressed through a central hole, like the lead in the centre of a lead pencil. Flame arc carbons have a chemical core. With direct current, however, it is only the upper or positive carbon which is cored. This positive carbon must be of considerably larger diameter than the negative one, as has already been noted. For a 35 amp. D.C. arc, the minimum size of carbons should be, upper 16 millimetre diameter cored, lower 12 millimetre solid. Where 50 amps. are being taken, the top carbon should be at least an '18' cored, and the lower a '14' solid, to use the customary abbreviated way of speaking of them. Many operators use larger sizes for the same current consumption. Size of carbons will also be found to be in a measure dependent upon the voltage of the electrical supply. For instance, considerably larger carbons can be used at a given amperage where the voltage is say 100 or 110, than where the voltage is only 60 or 65. With low voltages, moreover, the air gap between the carbons has to be kept so short as to cause the lower tip to interfere more or less with the light from the crater. Also low voltage arcs have a very bad habit of collecting conglomerations of incompletely volatilised matter from the core of the positive carbon upon the tip of the negative one. The projection light is thereby ruined until the collected matter has been knocked away by a sudden blow of the operating box screw-driver or other equally handy and unsuitable tool. On the other hand, high voltages have their own drawbacks, such as wastefulness of current. An arc consuming 30 amps. at 110 volts will give a light practically no different from one consuming the same current at 60 volts, yet the running cost of the former will be almost twice that of the latter. Moreover, where the voltage across the arc is comparatively high, the light will burn long without attention but with an ever-diminishing efficiency —very much longer than where the voltage is low. Consequently, the temptation to a careless operator to feed his lamp but seldom becomes greater the higher the potential across the arc.

The best voltage for projection is 70 to 75. This is very economical. At the same time it is just high enough to ensure a good clean burning negative carbon, with unobscured crater upon the positive pole.

THE RESISTANCE.—A resistance is employed to limit and control the amount of current which will flow in a circuit. A resistance is absolutely essential in every arc circuit. It is sometimes asked why kinematograph dynamos are not made to give the exact voltage required for the arc and so avoid wasteful resistances. The reason for this is as follows: The arc itself has practically no resistance, the voltage which is measured across the arc being the result of a back pressure, which is generated by the arc, and which acts in opposition to the main supply. The back E.M.F. of an arc is about 35 volts. If the pressure in the mains were no higher than this each would neutralise the other, and so no current would flow, making an

arc impossible. The amount of current which will flow through an arc is therefore exactly dependent on the number of volts over and above this first 35, and which superfluous voltage acts on the line resistance.

This number is obtained by deducting the 35 arc volts from the supply volts. The number of ohms required for the arc resistance is then arrived at by dividing the resulting figure by the required amperes. (See Ohm's Law, page 162.)

The usual type of kinematograph resistance is one which can be adjusted to give various strengths of current, and generally consists of a metal frame carrying suitable insulating panels, between which spirals of resistance wire are fixed. These spirals are so connected that current passes through each in turn. Connections are also made from a number of these coils to contacts on the lower panel, and by means of a regulating switch on these contacts the amount of resistance in the circuit, and hence the current, can be varied. As the switch is rotated from left to right, the current is increased accordingly, as the resistance coils are cut out of circuit.

The diagram will make clear the arrangement of connections.

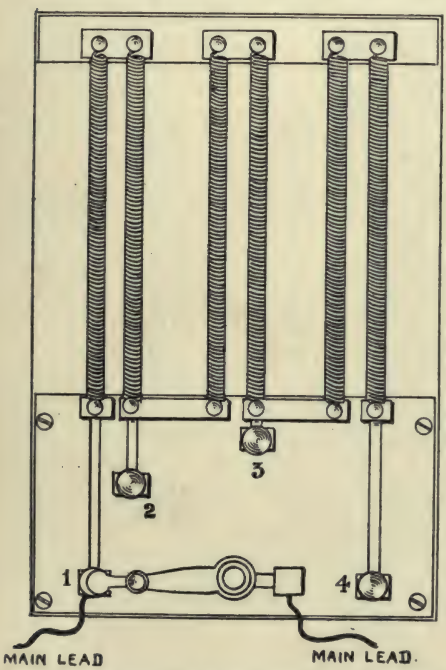


FIG. 136. SIMPLE REGULATING RESISTANCE WITH THREE POINTS AND "FULL ON."

Of course, in addition to the resistance frame mentioned above, a certain amount of ohmic opposition to the flow of current is always to be found in the circuit. There are the carbons, for example, and bad connections, etc. In the case of the carbons, the resistance is a varying quantity, for it decreases as the carbon burns away. For this reason, it will be noticed that on a low voltage supply, say 70 volts or so, a small variation in the resistance of the circuit, due to the carbon burning away, will make a considerable difference to the amount of current flowing, but on a high voltage supply this same variation will be relatively small, and therefore will not alter the current value so much. The importance of careful feeding and good quality carbons will now be seen, especially for the lower voltages.

Resistances should be capable of reducing the arc current to relatively small proportions, so that at starting up, the lenses and the apparatus generally may be warmed up gradually, to avoid sudden expansions, which would cause breakage, to say nothing of burning out the windings of motor generators through overload.

There is often much misunderstanding as to the correct gauge of resistance wire required for certain currents. In this connection, ventilation is a more important factor than the mere gauge of wire, and calls for consideration first. Efficient ventilation is essential. This means the coils must not be arranged too close together. Air must circulate freely between the spirals if it is to carry away the generated heat. Where resistance frames are designed with proper regard to their ventilation, the following table of gauges may be taken as fairly reliable. It should, however, always be borne in mind that smaller gauges of wire can be safely employed where there is plenty of ventilation, but in enclosed situations it may be desirable to use much heavier gauges. It is here also important to note that where the current is large, considerable saving will accrue from using a number of thin wires in parallel in preference to one thick one singly.

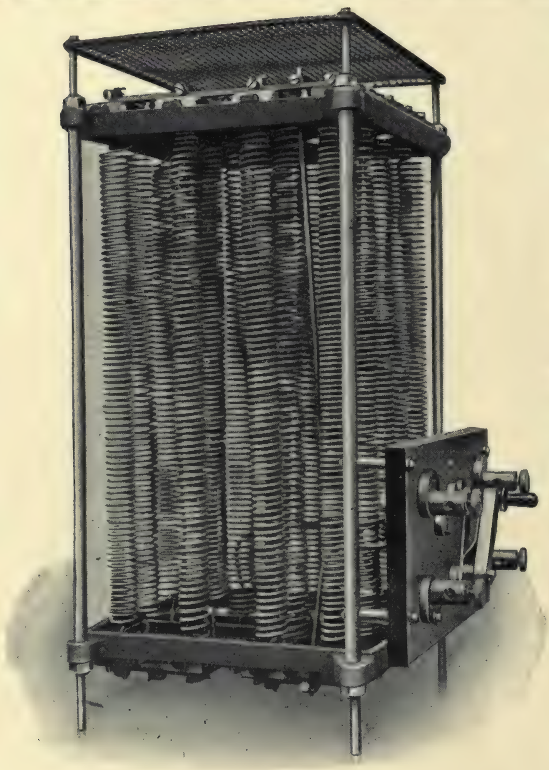


FIG. 137. A PRACTICAL REGULATING RESISTANCE.

SAFE GAUGES OF RESISTANCE WIRES FOR VARIOUS CURRENTS.

For resistance wires having a specific resistance of 50 microhms per c.c. Such alloys are known by the names of Eureka, Constantan, Manganin, Platinoid, German Silver (30 per cent.), etc.

6 amps	19g
7 ,,	18g
9 ,,	17g
12 ,,	16g
15 ,,	15g
17 ,,	14g
20 ,,	13g
25 ,,	12g
30 ,,	11g
35 ,,	10g
40 ,,	9g
50 ,,	8g

Fuses.

These are of the greatest importance. Of the few fires which start from electrical causes the majority probably owe their origin to carelessness in regard to some fuse or other.

A fuse is a short length of metallic conducting wire suitably enclosed and connected in series with the circuit through which current runs. This wire is purposely chosen of such a current-carrying capacity that should the circuit become overloaded, the fuse will get hot enough to melt, thus breaking the circuit and cutting off the current.

Fuses are of several different kinds. Some are made of lead, some of tin, such being employed where the current in the circuit or sub-circuit is only of small quantity, say up to twenty amps., or thereabout. For larger loads, tinned copper fuses are admittedly the best, and for use in the projection arc circuit they are the only kind which may be relied upon, since they are far more tolerant of the sudden overload unavoidable at the moment of striking the arc than are fuses of the softer metals. The usual tin and lead fuse capacities are five, ten, and twenty amps. Reels of such wire are sold at all electrical stores, and should never be far from the operator's hand when in the box, or by the switchboard. For the fuse controlling a forty or fifty amp projecting arc, a single strand of No. 20 tinned copper wire is the thing. It is purchased wound ready for use on pound or half-pound reels.

The best form of fuse at the present time consists of tinned copper wire made up inside an insulating cartridge. Cartridge fuses are fitted with copper lugs at either end, which grip by means of spring pressure upon terminals on the inside of a covered terminal box. With these fuses there is absolute protection from the splashing of molten metal. Also, the cartridges being enclosed, it is not easy for an incompetent electrician to introduce fuse wires into the circuit of such over-large capacity as to be no real protection against overload of the regular cable. Lastly, cartridge fuses are renewable in a minimum of time, an item of consequence when one blows in the middle of an exhibition.

Insulated Cable and its Current Carrying Capacity.

Needless to say, no system of fuses can be of avail unless the cabling of the electrical circuit is properly insulated, and the joints well and carefully made. Of all substances which act as insulators or checks to the flow of electricity, india rubber, paper, tarred braid, and bitumen are among the best. Transversely cut electric cable of good quality will therefore invariably show several distinct yet closely superposed layers of these current resisting substances. Only specimens of electrical wiring where such covering is stout and well put on should ever be included in the electrical installation of a kinematograph show. When ordering such insulated cable, one should specify distinctly 'association cable.' This stipulation assures that the insulation

will be up to a definite standard of reliability. Also, one must be very careful to see that electrical wire is never overloaded whether it be of small or great current carrying capacity. Appended is a table giving the current-carrying capacities of wires of various gauges.

CARRYING CAPACITY OF WIRES AND CABLES.

It will be noted that the standard adopted is that in which a conductor with a cross section of one square inch is considered as able to carry a current of 1,000 amperes. This standard is sufficiently exact for all ordinary purposes, but it may be pointed out that the carrying capacity of conductors has been the subject of much investigation, and that the Institution of Electrical Engineers has revised the figures somewhat. The difference between the two standards is not great, and for the sake of reference, both figures are given in the table ; it may be said, however, that the kinematograph operator will be erring on the safe side if he adopts the 1,000 amperes to the square inch standard for ordinary use.

Standard Wire Gauge.	Amperes at 1000 to 1 square inch.	Amperes at I.E.E. Standard	Standard Wire Gauge	Amperes at 1000 to 1 square inch	Amperes at I.E.E. Standard
22	.61	1.7	7.21	5.53	10.63
21	.80	2.2	7.20½	5.86	11.19
20	1.01	2.6	7.20	7.00	12.90
19	1.25	3.2	7.19	8.64	15.34
18	1.80	4.2	7.18	12.46	20.68
17	2.46	5.4	7.17	16.95	26.62
16	3.21	6.8	7.16	22.14	33.12
15	4.07	8.2	7.15	28.03	40.22
14	5.02	9.8	7.14	34.59	47.80
13	6.64	12.4	19.20	18.99	29.23
12	8.49	15.0	19.19	23.43	34.74
3.25	.92	2.45	19.18	33.75	46.85
3.23	1.33	3.30	19.17	45.93	60.33
3.22	1.81	4.25	19.16	60.00	75.06
3.20	2.99	6.44	19.15	75.86	91.12
3.18	5.32	10.31	19.14	93.72	108.30
7.25	2.16	4.92	19.13	123.85	136.2
7.23	3.11	6.63	19.12	158.26	166.4
7.22	4.23	8.54	37.16	116.80	129.6
7.21½	4.86	9.56	37.15	147.8	157.3

Single stranded conductors, from 22 to 12, have been included in the table. This has been done for the sake of reference, but it must be pointed out that modern practice does not favour the use of single wires. Of the sizes given, only the 18 S.W.G. is used to any extent at the present time, and many engineers prefer to use instead the 3.22 size, which is a stranded conductor made up of three wires of 22 S.W.G. The objection to single wires is that they are less flexible than stranded wires of the same total carrying capacity, they are more liable to injury when the insulation is bared, and cases have been known where they have fractured when bent at a short radius. For interior wiring, the sizes with which the kinematograph operator will be called upon to deal are 3.22, 7.22, 7.20 and 7.18. For the lantern, however, such heavier sizes as 19.16 or 19.15, according to the amperes required, will have to be used.

ELECTRICAL JOINTS are to be avoided whenever possible. When, however, they are essential they should *always* be "sweated" ; that is to say, ends of wire intended to form part of an electrical circuit should be so affixed to each other that the cable is electrically continuous. A badly made joint may get hot, and may thus cause a fire. Large cables should never be joined by an inexperienced hand as the consequences of bad workmanship would be serious. Before cable ends can be sweated together with solder they must be thoroughly cleaned of all rubber or grease and then carefully twisted together in such a manner that good electrical contact is made. A small quantity of 'flux' is then applied to the joint. This prevents oxidation of the wire and allows the solder to run freely when the joint is heated. Success with soldering depends on using a very hot clean iron, on thoroughly cleaning the joint, and on using a good flux. Acid fluxes must not be used for electrical work. The joint, when made, is neatly taped up with rubber and special black tape.

Leads of large capacity are usually sweated into lugs of copper or brass. These lugs may then be conveniently bolted up with main switches, ammeters, etc.

LAMP INSULATION.—The current-carrying parts of a projection arc lamp are insulated with mica, this insulator being perhaps the most suitable, as it is capable of withstanding the great heat. Should the insulation fail for any reason, then the current will pass through the metal parts of the lamp, avoiding the carbons and so not forming an arc. This would be called a short circuit, or, more simply, a ' short.' It is always desirable to keep a small quantity of mica at hand for temporary repairs.

WHEN CONNECTING THE D.C. ARC with the leads for the first time it may give some difficulty to the novice to determine whether he has really made his top carbon the positive, and the bottom one the negative pole. The simplest way to test is by striking the arc and letting it burn for a minute or two. If now the current is turned off and the two carbons examined after the lapse of 15 seconds, whichever shows the hottest tip will be the positive one. Should the ruddy cherry glow indicative of the positive pole be on the upper carbon, we shall know all is as it should be. If, on the other hand, the best part of this after glow is given off by the underneath carbon it is a case of reversing the wiring connections to the lamp terminals.

Other indications that the poles of the projection arc are wrong are the casting upward instead of downward of the light, refusal of a proper crater to form on the upper carbon, and an unsteady puffy flicker of the flaming gasses in the air gap.

CURRENT CONVERTING AND TRANSFORMING.

We have already pointed out in this chapter that the best voltage of electric supply for kinematograph projection purposes is 70 to 75. Incidentally, this same voltage is by no means over low for the incandescent electric lighting of a single building, especially where metallic filament lamps are in use. It may therefore be taken that when—as where a picture hall owns its private generating plant—the whole installation is at 70 or 75 volts, there will be a great gain on the running of the arc and little or no loss elsewhere. When, on the other hand, the hall takes its electrical supply off the public mains, it is likely the voltage will be a higher one. Suppose it is 220 or more, then the only practice consistent with economy will be to " transform " or " convert " down to the required pressure.

The voltage of alternating current is easily altered to almost any value, either high or low, by means of a static transformer. This apparatus consists of two coils of wire arranged around an iron core, the number of turns of wire on these coils being proportional to the ratio of voltage transformation required. One coil—the primary—is connected to the mains, and the effect of the flowing current is to

create a magnetic field in the iron core. This magnetic field threading through the other or secondary winding causes a new current to be generated in it, which has a voltage dependent on the number of its turns. A static transformer only alters the potential or pressure of the current. It does not alter the quality of the current. Current transformed in this way is still alternating, and is of the same frequency on the secondary as on the primary side of the transformer. The actual value of the current itself is transformed in inverse ratio to the voltage.

Thus, a transformer that is used to reduce the supply voltage say 3 to 1 will incidentally increase the amperage in the proportion of 1 to 3 with an efficiency loss of about 5 per cent. or 6 per cent. For illustration of a static transformer see fig. 138.

When dealing with direct circuit the matter is quite different. Here, since the electricity flows steadily in one direction instead of pulsating in cycles, no method of converting by means of simple induction could be of avail. Accordingly, resort is made to a transformer of the rotary type. Such transformers are in reality nothing more than small high potential electric motors driving low potential dynamos direct coupled on the one shaft. The waste of current in transforming by this method is much greater than that where high potential alternating current is to be converted to low, since now we have an actual transformation of our original electricity supply into mechanical energy on the one end of the shafting, the same mechanical energy being re-converted back to electrical force on the other end. The actual amount of current lost in process of conversion depends on the make of the machine, but is anywhere from 30 per cent. to 15 per cent.

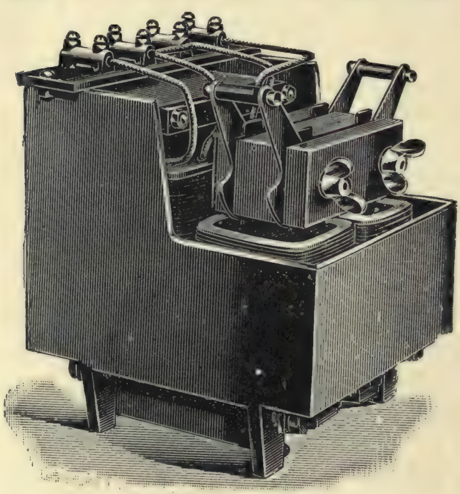


FIG. 138.—STATIC TRANSFORMER. Alters voltage of alternating current but does not convert it to direct current.

FIG. 139.—THE ROTARY TRANSFORMER OF THE VICTORIA DYNAMO AND MOTOR CO.

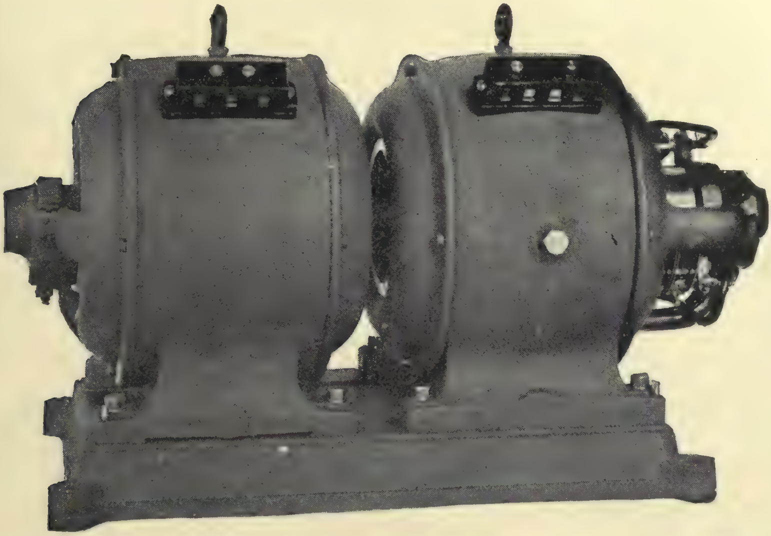


FIG. 140. MOTOR GENERATOR SETS (Two Machines on a Combined Bedplate).

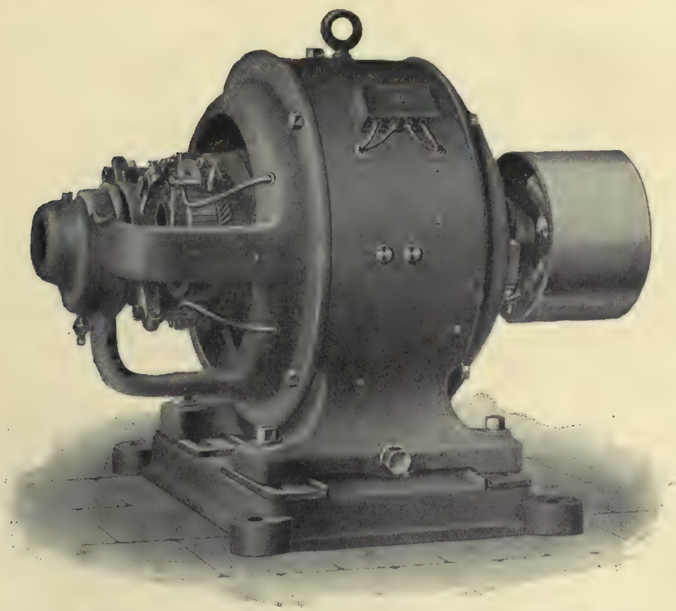


FIG. 141. DYNAMO DESIGNED FOR KINEMATOGRAPH WORK.

Private Generating Installations.

Where a public electric supply is not available, and unless limelight is decided upon as the illuminant for the projector, there is no alternative to making one's own current on the premises by means of suitable plant. The generator here will invariably be of the direct current type, and should be specified "compound" wound.

As previously explained, current is got from a dynamo by revolving a wound armature between the poles of a magnet. This magnet is itself electrically excited from current generated in the dynamo armature. Upon the amount of current allowed to flow through these magnet windings depends the strength of the magnetic field, and hence the voltage generated by the dynamo. In order to regulate this voltage, it is usual to put a variable resistance in the magnet winding to control the amount of current flowing. This latter is known as a "field" or "shunt" regulator.

So much for the dynamo itself. We already know that the voltage to stipulate is 70 to 75, at least, the latter is the writer's personal preference, though some current economists profess to find no great trouble in use and some further current saving by installing a 60 volt supply. For a medium sized hall the arc will probably take 50 amps, so that allowing 25 amps more for interior and frontage lighting and a small margin on top of that, we shall find an 85 amp set to be about what is required.

Now to consider how the dynamo is to be driven. The following are alternative possibilities. We may drive by means of :—

Steam power,
Town gas (ordinary gas engine),
Suction gas,
Petroleum gas,
Petrol,
Water power.

The last of all would, of course, be the cheapest in those country districts where it could be installed. Occasionally in small country towns or their outskirts one comes across a water wheel converted so as to drive a dynamo to good purpose. This experience, however, is by no means a common one in England, and with that we will pass on to the other more likely forms of driving power.

Steam is in many ways ideal for large electric installations. The running of high speed steam engines is particularly smooth and free from jar. The same applies in even greater degree to steam turbines, which are, of all forms of driving power, quite the best for running dynamos. Steam is not, all the same, by any means the most economical form of power, besides requiring more attention than will usually be convenient to expend upon it when utilised for kinematograph purposes. Also steam engines with their attendant boilers are both costly and bulky. Small steam engines are even less economical than

larger ones. Practically, therefore, good as is this form of motive force, it has to give way before others in the driving of small private electric supply installations.

Exception to this last statement must, however, be made in the case of touring and portable kinematograph shows which travel their own fit-up by road. Here the ideal lighting system is to use electricity generated by means of a high class compound steam road (traction) engine fitted with dynamo carried on the front plate. Such a road engine is employed both for lighting and also for haulage purposes, whereby the expenses of travel are cut down to a minimum. In fact, the system of lighting and haulage here touched upon has been in constant use for years by proprietors of roundabouts and large movable bioscope shows.

TOWN GAS.—We now come to the most popular source of energy for our purpose. The gas engine is known to everyone as a cleanly and simple means of obtaining mechanical energy for all manner of diverse purposes. It nearly always works on the Otto cycle. That is to say, power is communicated to the fly-wheel as the result of an explosion of mixed gas and air occurring inside the cylinder once in every two revolutions. Thus :—

> *Revolution One.*—Mixed gas and air are drawn into the cylinder through suitable inlet valves as the result of suction brought about by the outward thrust of the piston. The energy for this is derived from previous momentum of the fly wheel. As the crank turns into position to send the piston back again, the inlet valves automatically close. Consequently, this backward strike compresses the gas and air mixture into small compass in what is termed the 'explosion chamber' at the far end of the cylinder. At the end of this backward stroke and when compression has reached its height means are found of igniting the compressed and explosive mixture in the cylinder end, and
>
> *Revolution Two.*—The gases expand enormously as the result of explosion, the pressure of the burnt product in the cylinder tending strongly to force the piston out again. This outward thrust causes the crank and fly wheels to take on further and increased momentum. On the second backward stroke of the piston, the exhaust valve of the cylinder opens, blowing out the burnt-up gases and leaving the cylinder clean and ready to take in further charges of gas and air wherewith to repeat the above 'Otto' cycle.

Well-known and trustworthy examples of the gas engine are to be found amongst such models as the National, Crossley, and many others. These gas engines work very evenly, give little trouble, and only require a comparatively small amount of cleaning to do their work well. Usually they are connected with the dynamo for driving by means of an endless belt. Latterly, however, several direct-coupled

sets have made their appearance. These possess the advantage over belt-driven sets of a saving of something like 15 per cent. of power otherwise lost in belt transmission.

When belting is used for driving purposes, allow at least one-half inch width for every horse power to be transmitted to the dynamo. This presupposes the belt to run at normal speed, about 2,000 feet per minute. Driving should always be forward, that is to say, with the slack of the belt on top. In apportioning power of engine to dynamo for belt-driven sets it is useless to have the dynamo of much more than two-third power as compared to the driving power. Thus, a nine horse gas engine will not comfortably do more than drive a four and a half kilowatt dynamo on the belt system, though with direct drive, it might conceivably produce nearly an extra kilowatt of electrical energy.

Suction Gas.—The gas here made use of is not town gas at all, but a special brand produced by burning anthracite coal or coke in a 'producer.' The disadvantages of a suction gas plant lie in comparatively heavy first cost, coupled with a certain lurking suspicion of possible explosions if the producer is not looked after intelligently. The advantage lies in extreme economy of running cost of the installation. There is no doubt that where properly understood and reasonably carefully controlled, suction gas is next to water power the cheapest of all sources of mechanical—and hence of electrical —energy.

Petroleum.—Where town gas is not available for our dynamo driving, and it is not wished to go to the somewhat heavy first cost of a suction gas plant, we may substitute oil in the shape of ordinary petroleum. Oil engines are manufactured by several reputable makers such as National, Blackstone, Tangye, etc., and are of solid construction, and in appearance very much like gas engines. Also, their performance is equally satisfactory for short runs. Their disadvantages are smell (which is usually cruel), and the necessity for constant cleaning, involving taking the whole engine to pieces pretty well every week. If cleaning is neglected ever so little power begins to be lost, and running costs in oil consumption to go up enormously. Even at their best, petroleum engines work out more expensive in running—perhaps half as much again—as town gas engines.

Both town gas, suction gas, and petroleum engines are now made in models expressly intended for electric lighting. Such are provided with extra heavy and specially balanced fly wheels, and are capable of driving a dynamo so as to give an output steady to one volt on the meter. This performance is very good indeed, as need hardly be pointed out.

Whatever type of engine is used, great care must be exercised over lubrication, or bearings will seize and soften. Once this happens they will give trouble ever afterwards. Never start an engine until it has been ascertained that all ring bearings and oil cups are properly fed with lubricating oil.

PETROL SETS.—Petrol sets are the order of the day. They possess many attractive points, notably small and compact configuration, lightness, portability, simplicity in starting (provided adjustments are correctly made) and such like interesting features. Petrol comes

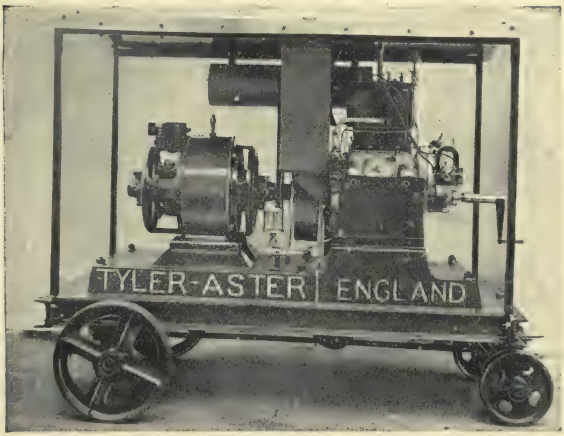


FIG. 142. THE TYLER-ASTER GENERATING SET.

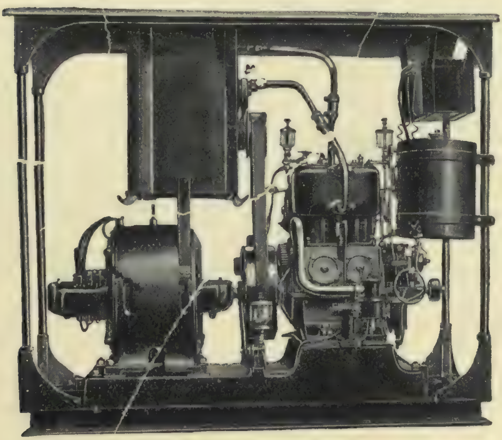


FIG. 143. A COMPACT PETROL GENERATING SET.

out in working somewhat dearer than petroleum, but these portable petrol sets being of the direct drive type are thereby more economical than if a belt drive were employed.

Like all oil engines they have to be kept clean if satisfactory results are to be expected. Mostly they are fitted with high tension magneto ignition which is in itself very reliable, as is shown by the fact that it is coming in more and more for gas and petrol engines of every description.

For touring kinematograph shows of the kind which hire and fit up in provincial halls these petrol sets may and should prove very useful. Needless to say, where long runs in one place are to be coped with, the advantage would seem to lie with a more solidly constructed town or suction gas plant.

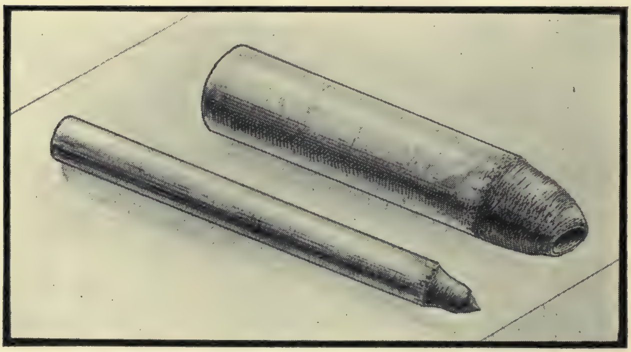


FIG. 144. A WELL BURNED PAIR OF CARBONS.

CHAPTER V.

LIMELIGHT AND MINOR ILLUMINANTS.

Where the kinematograph is only to be exhibited occasionally and in neighbourhoods distant from a town electric supply, then the one real alternative light to electricity is limelight as produced by the impinging of a burning jet of mixed oxygen and hydrogen (or coal gas) upon a cylinder of hard lime.

Under these conditions, a very good light may be obtained emanating from a comparatively small source, and approximating in intensity anywhere up to 2,500 candle power, according to the skill and lavishness of the operator in using his gases. With a wide aperture projection lens such a light will prove adequate for a well illuminated moving picture up to eight feet diameter. The writer has read wondrous stories of fourteen feet pictures illuminated brilliantly by means of the oxy-hydrogen jet, but he would not personally care to attempt the projection on this scale and with this illuminant of any but specially picked, lightly printed film subjects.

Years ago, when kinematograph projection was in its infancy, the bulk of shows were given with limelight, and it was then the rule to keep the positive pictures very thin so as to make the illuminant go as far as possible. Nowadays electricity has come in almost to the exclusion of the other, and consequently, modern kinematograph films are made correspondingly dense in the shadows. Hence the fact of it is, the limelight operator has to curtail the dimensions of his picture more, and attempt a far less ostentatious show now than formerly. He may help himself to some extent by employing as the objective of his projector one of the newer extra wide diameter makes. Even here, however, there are pitfalls in his way, since, unless this same wide aperture lens be the somewhat expensive product of a reputable firm such as Busch or Dallmeyer, he will find the clearness of projection, especially at the corners of the screen, diminish in proportion as added brightness is gained.

Thus, if a rule be laid down at the start for the guidance of limelight operators in deciding upon throw and dimensions of the picture, it had better be the following admittedly conservative one. Keep to projector lenses of good quality and wide aperture, also limit the throw from lens to screen as much as possible, and do not attempt to show a large picture where the throw is great any more than where it is small. Where limelight is in use a wise limit of throw (distance between projector lens and projection screen) will be thirty-five feet or thereabouts in the case of small exhibitions.

Within these limits, however, really brilliant limelight pictures may be projected.

The actual apparatus for the work consists of the jet, connecting tube, limes, oxygen and hydrogen (or coal gas) in cylinders, cylinder regulators, gauges, cylinder key, lime tongs and borer, lime tray for the jet, and wire for wiring on the tubing.

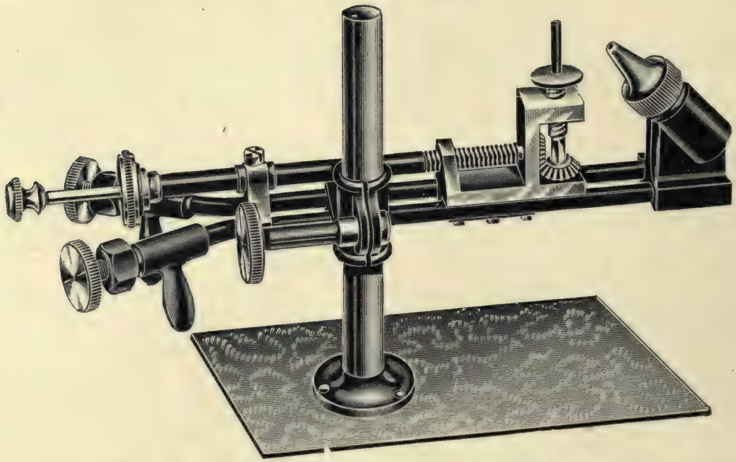


FIG. 145. THE "WALTURDAW" HIGH POWER MIXED JET.

The jet to use is technically known as a ' high power mixed. It consists of a strong metallic chamber filled with sheets of perforated metal or metal gauze through which streams of the two gases are forced by the pressure behind them. While penetrating the gauze the gases mix prior to issuing from the nozzle of the lime jet. To start a mixed jet a tube is connected with one of the taps and its other end wired to the regulator upon the oxygen cylinder. A second similar connection is made up with the hydrogen cylinder. With limelight of this class it does not usually matter which tap on the jet is connected with which cylinder. See that the jet taps are closed in starting. The main valves of the cylinders are now opened wide by means of the cylinder key. If the regulators are working correctly nothing will happen beyond the accumulation of a certain amount of compressed gas in the respective lengths of tubing. Now turn on the tap admitting hydrogen or coal gas to the mixing chamber. There should be placed upon the lime pins a cylinder of lime previously made hot. Apply a match to the hydrogen issuing from the nozzle and it will burn in the ordinary way. We now adjust the distance of this jet nozzle to about one eighth of an inch, or slightly more from the surface of the lime. This is done by means of the screw adjustment provided for shifting the lime gallery backward and forward. Finally, turn on the oxygen tap gradually. The first effect will be to make the hydrogen flame appear to get smaller. If it gets

too small turn on more hydrogen and also more oxygen and shortly one of two possible things will happen. The jet will begin to hiss loudly, or the light at which we are aimimg will show itself. If the former, turn off the hydrogen gradually till the hissing stops, and then turn on more oxygen, and so on till the light comes.

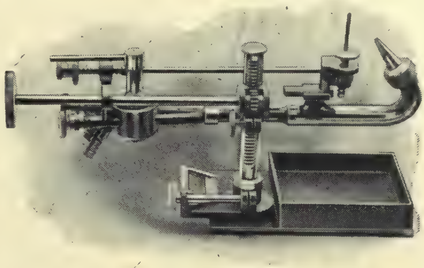


FIG. 146.
GWYER SPECIAL KINEMATOGRAPH LIME-LIGHT JETS.

The sought-for illumination will show itself as a spot of incandescence arising and growing in brightness upon the lime cylinder. Careful adjustment of the gas taps will cause this incandescence to increase till the whole front face of the lime is white hot and glowing fiercely. Hard limes for kinematograph purposes are usually one inch high by one or one and a quarter inch in diameter, so that high power limelight does not give nearly so concentrated an illuminant source as electricity. This difference will duly show itself as a woolly yellow margin to the light pencil around the projector gate, necessitating a larger circle of illumination with consequent loss of effective light on the mask aperture. Moreover, the impinging of the extremely hot mixed gases upon the face of the lime cylinder has the effect of burning it away, more or less, such burning or volatilisation taking the form of pits which necessitate turning the lime round from time to time. For this reason, every limelight jet is fitted with a lime turning adjustment in addition to the backward and forward motion of the lime gallery from the nipple. The lime turning actuates corkscrew fashion, so that theoretically it should be possible to pit the lime over the whole of its face before it would be burned out. Practically, no lime will withstand the temperature of the mixed burning gasses for so long without cracking. It is the business of the operator to turn the lime slightly every couple of minutes, otherwise, in addition to loss of light, there is great danger of the hollow cup-shaped pit formed in the incandescent material causing the flame to strike back at an angle and hit the condenser, with the inevitable result of a smashed glass.

ECONOMY IN THE USE OF MIXED GASES.

It is possible to burn a mixture of gases widely differing from the theoretical correct proportion of each constituent and still get a very passable light. Such mixtures will, notwithstanding, be inefficient and wasteful. The way to ensure that the mixture of oxygen and hydrogen passing through the mixing chamber and to the jet nipple is rich enough without being too rich is as follows :—

Having got the lime to glow by means of the rough gas adjustment already described proceed to turn down the hydrogen or coal gas (not the oxygen) till the quality of the light suffers. Now once more turn up the hydrogen slowly till the point is just reached at which full light is maintained for the existing oxygen consumption. This will now be the perfect mixture of gases for the work. Should it be desired to increase the light, turn on more oxygen slowly and follow by admitting correspondingly more hydrogen (or coal gas) till the advance in brightness of the glowing lime ceases. To lessen light with economy of gases, turn down the oxygen first, then proceed to turn off hydrogen till the diminution in the lime's brightness which took place on lessening the oxygen supply partially recovers itself —that is to say, till it recovers itself so far as is possible with the reduced amount of mixture.

Centring the illuminant will be dealt with in the next chapter, the remarks to be written concerning it applying equally well both to lime and electricity.

Turning to the gases themselves, we have already stated broadly that these are stored in cylinders. Such cylinders are supplied of mild weldless wrought steel of great strength and comparative lightness. A twenty-foot gas cylinder, for instance, will weigh somewhere about twenty-five pounds. For kinematograph work small sized cylinders are not so useful or so economical as larger ones. Sixty-foot sized cylinders come under the cheaper charging rates of the companies supplying compressed gas, while they are also sufficiently portable to be moved single handed by a muscular man. Gas cylinders of 100 foot capacity are made where even larger supplies are necessary. All these are thoroughly tested before leaving the compressing houses, and only such as have stood on test an internal strain approximately three times as great as the normal charging strain are allowed to go on the market. The security of the public in handling them is thus seen to be very great.

Oxygen cylinders are painted black, and have the ordinary right handed threads cut upon their valves. Hydrogen cylinders are painted red, and the screw threads are left handed, this affording a further safeguard against the possibility of wrong charging at the works. Oxygen for storing into the oxygen cylinders is obtained from the air we breathe by means of the patent 'Brins Process,' in which the substance Barium Peroxide is made alternately to discharge oxygen and re-absorb it from the air under the influence of varying pressures. Pure hydrogen gas (where this is stipulated by the consumer) is made from zinc and sulphuric acid after the manner adopted by the old gas bag operators. More usually, however, coal gas is used with the oxygen to form the gas mixture. Coal gas does not give quite so high a temperature on burning, but it is both cheaper to buy in its compressed state and also much more economical in use. Ten feet of oxygen require twelve feet of coal gas, or in the alternative, twenty

feet of pure hydrogen to form the burning mixture, and the difference of light obtained is only slightly in favour of the latter much more expensive material.

A high power lime jet burning its best will take at least the last mentioned amounts of gas per hour. Thus a sixty foot oxygen and eighty foot coal gas cylinder will be sufficient for about six hours limelight with the kinematograph.

The gases, as stored in cylinders, are under so great pressure that adjustment of them by means of the jet taps would be a sheer impossibility were it not for the employment of special regulators affixed to the cylinders themselves.

THE WALTURDAW GOVERNOR FITTED WITH BABY GAUGE

FIG. 147.

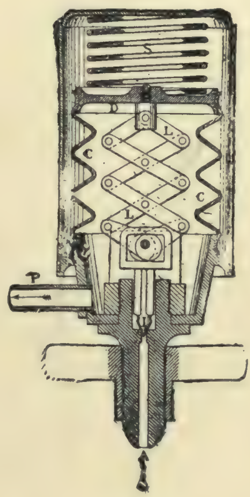


FIG. 148. SECTIONAL VIEW OF INTERIOR OF GAS PRESSURE REGULATOR.

Gas regulators work upon a simple principle. A lazy tongs is enveloped in a strong airtight leather bag or 'bellows,' having a metallic cover to the inside of which one end of the tongs is pivotted. Turning gas from the cylinder into the regulator fills this bag, thereby causing it to stretch upwards towards a counter spring placed outside its stiff metal cover. This upward movement is transmitted to the lazy tongs as a downward thrust of the end of its arms nearest the gas orifice, and the downward thrust acting on a finely adjusted metallic plug stops the gas flow as soon as the pressure in the leather bag is sufficient to press back the external counter spring to a pre-determined amount. Seeing that the internal pressure of a full cylinder is 120

atmospheres, or 1,800lbs. per square inch, it goes without saying the work the regulator is called on to perform in bringing this enormous pressure down to the equivalent of two or three inches of mercury is by no means light. It is therefore necessary to keep a sharp eye upon this part of our apparatus, and be ready at once to detect minor leaks or signs of wearing in the bellows or bag.

Leaks are best detected by putting one's ear to the side of the regulator while the gas is turned on at the cylinder tap, but not at the jet taps. An internal hissing will mean leaking either of the regulator bellows or of the tubing between it and the jet. Which of the two is really at fault is a matter that ought not to take any operator long to discover for himself. Another way of testing a regulator is to remove the tube from its delivery pipe, close it tightly with the thumb, and then turn on the cylinder cock by means of the cylinder key. Any continuous hissing heard must now result from leakage of the bellows or around the screw threads and their connections, to find which, plug the regulator delivery pipe, turn on the gas again, and immerse the whole upper end of the cylinder, with regulator, in water. Bubbles coming from the hole in regulator top then denote worn-out bellows, while bubbles from elsewhere tell their own tale as to indifferently made connections or battered screw threads, resulting from knocks in course of railway transit.

One of the latest ideas in regulators is to have the counter spring upon which pressure of gas delivery depends made so that it can be tightened up at will. Both Beard and Brin have a regulator fashioned on these lines, though in Brin's pattern the leather bellows gives place to a metallic diaphragm. Such variable gas pressure regulators are chiefly of use in controlling the oxygen supply where limelight is produced by means of the injector jet.

Cylinder Gauges.

The cylinder gauge is—like the motor drive of a projector—a matter which may prove a blessing or a curse according to how it is used. The careful operator will be able to save pounds in a very short time by the intelligent checking of his cylinder contents by means of gas pressure gauges. On the other hand, these same gauges are very delicate pieces of mechanism, and rough usage of them has to be strenuously avoided or they will turn out more trouble than they are worth.

Undoubtedly the best way to run a gauge is to have it permanently fixed upon a branch connection of the regulator fitting. Thus mounted it is always available for consultation, just like the gauge of a steam engine. Also, it is for ever at the mercy of the rough-handed should they take it into their heads to push the heavy cylinder about in a careless manner. It will then only take a comparatively slight bump to smash the gauge glass and bend the branch tube sufficiently to make the whole fitting leak badly.

A sort of half-way house in the use of gauges is to have them fitted so as to be interchangeable with the regulators. In this case they will only be available between, and not during, shows. Moreover, the constant screwing and unscrewing of threads is none too good, and minor leakage may well also result from it.

Oxygen and hydrogen gauges work upon the well-known principle used in the case of testing steam pressure, and also adapted in modified form when testing atmospheric pressure by means of the ordinary aneroid barometer.

Under this principle compressed hydrogen or oxygen from the cylinder passes without entering the regulator into a thin-walled curved metal tube contained within the gauge cover. The tube has a tendency to straighten itself in increasing extent according to the difference between its internal and the external atmospheric pressure. As the tube straightens, the movement of its free end causes rotation in a series of toothed wheels actuating the pointer on the gauge dial. Barring accidents due to carelessness in handling the only thing about a gauge which is liable to go wrong is the breakage of the thin internal pressure tube itself. Should this burst one soon knows it by the rush of escaping gas, coupled with an unearthly buzzing sound due to the vibration of the broken end. There is no way of plugging up a broken gauge tube and going on with the show, so the light will just have to be shut off while the whole fitting is removed, and a new regulator union without gauge branch substituted.

In reading a gauge, whether oxygen or hydrogen, the great thing to remember is that thirty atmospheres indicates quarter full, sixty atmospheres indicates that the cylinder is half full, ninety indicates three-quarters full, while at the figure 120 will be found a red mark showing that this is where the pointer should come to rest when the cylinder is returned quite full after charging. From the above figures it will not be difficult to calculate how many feet of gas there are actually in any cylinder at any time. For instance, say our cylinder is a forty-foot one and it reads thirty on the gauge. It is then quarter full, which means that there is in it ten cubic feet of gas. Supposing it to be an oxygen cylinder we shall know ourselves to have just enough gas left for one bare hour's show.

In addition to the foregoing, some gauges are now also figured to show the number of feet there would be in a ten-foot cylinder. With such a gauge, supposing the case of a sixty-foot cylinder and the pointer standing at five (meaning five feet in a ten-foot cylinder), multiply the figure by six, since our cylinder is of six times the capacity of the one for which the gauge was calibrated, and we get as our result the figure thirty. There are thus thirty feet of gas in our sixty-foot cylinder—the cylinder is half full.

In making connection between cylinder and regulator always see that the separate wing nut upon the regulator union is screwed down all the way into the cylinder thread before commencing to tighten up the regulator itself. In this manner very strong and airtight joints

may usually be made. Occasionally the writer has found even this to fail to make absolutely gas-proof joints. In such a case a very little hard grease run into the screw threads works wonders. Such practice cannot, however, be conscientiously recommended, since in the case of oxygen fittings the procedure is not entirely free from danger (at any rate, in theory) should any of the grease later find its way into the body of the cylinder. The writer does it all the same with the best results, only, it needs a lot of care.

It is possible to work the gases successfully for mixed limelight without either gauge or regulator. The omission of the former means that there will be a great danger of running short of gas unexpectedly, the only alternative being that the operator should keep well on the safe side of his cylinder capacities, entailing sending back cylinders before all the gas is used out of them. The absence of regulators is attended with many difficulties, one of these being the need to give constant attention to the main gas taps of the cylinders. When working without regulators the cylinder threads must have screwed into them what are known as fine adjustment taps. These, then, serve to control the gas flow in its entirety, both jet cocks being left full open at all times, otherwise the connecting tubing will be blown off and ripped by the internal gas pressure. Fine adjustment taps are merely strong screw valves controlled by means of milled heads. The reason of the fine adjustment taps needing constant attention, say every ten minutes or so during the show, is to compensate for lowering of cylinder gas pressure, which is now unbalanced by the bellows action of a regulator.

Injector Lime Jets.

These differ from ordinary lime jets in that while they obtain their feed of compressed oxygen from a cylinder, the coal gas they consume with it comes from the ordinary house supply, from which it is conveniently obtained by affixing a rubber tubing connection to any handy gas bracket. The system of the injector jet is the same as that of the steam injector of an engine boiler. A fine spray of steam blowing into a funnel-shaped passage way creates a draught, which gives rise to strong back suction tending to draw air or other gases in its track.

With the oxy-hydrogen light used on the injector principle the mixing chamber of the jet is modified into more or less of a cone through which a high pressure oxygen stream is driven, thus sucking into its track and driving through the jet nozzle coal gas, which fills the rest of the chamber. Needless to say, the mixture of gases in an injector jet is not so intimate as with the regular mixed gas variety. Consequently, the candle power realised on this system is not so good. 1,000 to 1,500 c.p. is the most to be expected from any injector jet. This power will be found fairly suitable for kinematograph projection up to say six feet diameter with two and a half and three inch focus objectives. Further, since no licensing authority would countenance

this system of lighting in regular kinematograph shows, the power available will probably prove amply sufficient for those conditions where the light is practicable, such as small charity shows, private house exhibitions, and the like. Remarks referring to the mixed gas display apply for the most part also to injector work, except that here it is necessary to have the cylinder regulator adjusted to deliver oxygen at not less than seven to ten pounds per square inch pressure. This entails the use of specially reinforced and extra thick 'injector' flexible tubing for making connections between regulator and

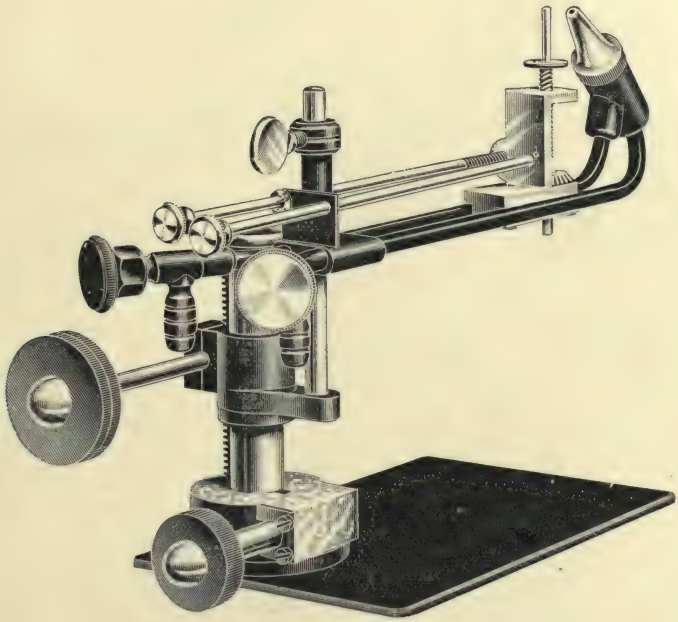


FIG. 149. THE "PRIMUS" INJECTOR JET.

jet tap. With the injector jet it is, moreover, essential that the oxygen is led into the oxygen feed of the jet, for which purpose this tap will be found to have the letter O engraved upon it. Wastefulness of the injector system is due to the high pressure oxygen stream inevitably drawing after it rather less than the theoretical amount of coal gas which would be necessary to bring about its complete comsuption. For all that, relief from the necessity to run the second compressed gas in a cylinder will be found to make injector work very much cheaper in practice than the employment of the mixed jet.

Injector jets are always more or less noisy in burning.

The following systems of illumination in optical projection as applied to the kinematograph are only of service for very small pictures and for those projected at home or in the schoolroom and experimental laboratory.

The Blow Through Limelight Jet.

With this jet, as with the injector type, coal gas is taken from the house supply, but here no internal mixture of any sort is attempted.

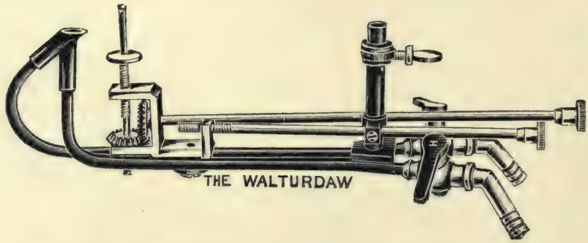


Fig. 150. The "Walturdaw" Blow-through Jet.

Indeed, the coal gas is first made to burn in a wide based ragged flame against the side of a soft lime cylinder. When light is required oxygen is blown through a narrow orifice into the middle of this coal gas flame. In the result, a portion of the coal gas becomes so raised in temperature as to transmit to the lime heat enough to bring about incandescence. Needless to say, this system is very wasteful of both gases, a consump-

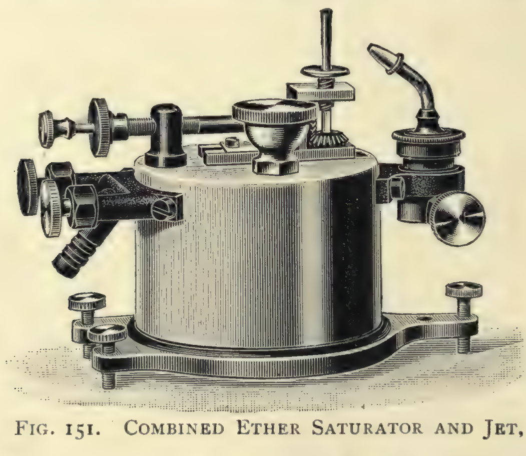


Fig. 151. Combined Ether Saturator and Jet,

tion of six feet of oxygen per hour giving a light not much over 400 candle power, or 500 at the most. The light is comparatively silent when skilfully managed. Any attempt to force it, however, at once gives rise to that peculiarly irritating hiss familiar to all of us who have

attended parochial 'limelight lectures.' Blow through limelight will serve for pictures up to three or four feet in diameter with the average modern kinematograph films.

Oxy-Ether. Oxy-Petrol.

This form of limelight would be most useful in kinematograph work were it not for a lurking suspicion as to its safety which cannot be dismissed from the mind of the conscientious operator, also for a tendency on the part of ether or petrol fumes, as the case may be, to pervade the air at such times as the light is burning. The form of jet utilised with oxy-ether and oxy-petrol may be the same as that used for high power mixed gas work. One cylinder of gas only is required instead of two, this gas being, of course, oxygen. Instead of employing the house gas supply, however, a branch off the oxygen supply tube is connected with a tank containing sponge or tow saturated with methylated ether, or in the alternative, ordinary motor spirit.

As the oxygen forces its way through the ether or petrol it takes up a surfeit of the vapour of it. This 'saturated' oxygen vapour mixture is then led to the hydrogen side of the jet. When the saturator is working well the charging of the original oxygen with vapour may be so thorough that the explosive point of the mixture is overpassed. Thus a quietly burning hydro-carbon vapour finds its way to the jet nipple on the hydrogen side. We then have what practically amounts to a lime jet burning gasified ether or petrol in place of coal gas, this being capable of being enriched with oxygen turned in from the oxygen lead for the purpose of raising the lime to incandescence, just as with the ordinary mixed jet. Moreover, the oxy-ether and oxy-petrol light is almost as brilliant as mixed gas at its best. Well over 2,000 candle power is available from such a source when the ether tank is full and working well—which it does when slightly warm.

But there is with all such systems the lurking fear that the ether or petrol supply may give out unexpectedly, and that the combustion of the impoverished mixture may proceed down the length of the jet and through the connecting tubing to the tank itself. An internal explosion would then be inevitable, and though a strong walled metal saturator might come out of it scatheless a weaker one may burst and do great damage. In any event, and even where the saturator withstood the explosion, there would be the sudden pop of the back-firing jet, the rip of bursting tube, and the nauseous escaping ether fumes permeating a darkened projection chamber, and with kinematograph audiences all on edge, as they are, for danger scares and causes of panic the prospect is not a nice one to contemplate. Latterly, the Home Secretary has ruled out as illegal systems employing saturators in kinematography. This can only be called a very wise precaution, though for laboratory purposes where a cheap

and powerful illuminant is required in connection with kinematograph experiments the oxy-petrol light is well worthy of remembrance as an alternative to electricity. Many patterns of saturators now on the market seem as safe as houses judging from their construction, but then—

Oxy-Spirit.

About a year ago, a French firm put on the market a projection lamp wherein boiling methylated spirit supplied the vapour necessary to the hydrogen side of a mixed gas limelight system. The writer has come across an example of this form of jet, and has heard well of it from the owner. It is said to give a light of quite 2,000 candle power. Moreover, it is economical in use, requiring only a comparatively small oxygen feed, but is very hot in working, owing to the spirit boiler with its attendant auxiliary flame which has to be kept going during exhibition. Altogether the light seems good enough and simple enough to merit careful consideration by those private individuals interested in projection work who may live away from a town gas supply and yet require some more powerful illuminant than acetylene. This spirit oxygen lamp is reported to be good for a six-foot projection with a throw of twenty-four feet.

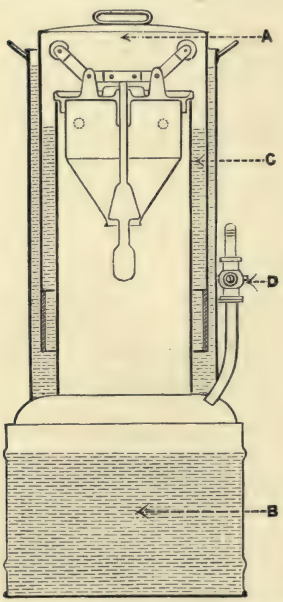


Fig. 152. A 'Carbide to Water' Acetylene Generator.

A Gas Container.
C Carbide Container fitted with automatically operated outlet for carbide at bottom.
D Acetylene delivery tap.

Acetylene.

With acetylene we come to a class of illuminant which is barely on the brink of utility for the amateur projection of moving pictures, but it may be used where a two or three foot picture will satisfy requirements. Acetylene, as everyone who owns or has owned—or has a friend or relation who owns or has owned—a bicycle, will know, is made by dropping water upon calcium carbide. When water falls upon carbide there arises a—an aroma. This is the aroma of acetylene, celebrated as at once the most highly illuminating and one of the most noisome gases known to science. Incidentally, its mixtures with the air are very explosive in very wide proportions, so that acetylene generators should be carefully looked after, especially when their containers are large and pretty full.

Acetylene generators are broadly divided into two classes, those in which the gas is produced by water flooding trays whereon is spread calcium carbide, and those in which the calcium carbide is automatically discharged little by little into water as circumstances may require. The first class of generator is a good knock-about form, but has the disadvantage that once the flow of gas starts it is difficult or impossible to stop it completely till the whole of the carbide charge is used up. Gas production may be stopped off partially, but there will always be more or less leakage going on—with attendant smell—due to the carbide remaining in an atmosphere full of water vapour.

The alternative or carbide discharge system is under the drawback that the mechanism here is more complicated and requires to be more carefully looked after. Further, the carbide used in charging the 'carbide to water' generator has to be crushed to a definite calibre and screened, all of which makes it more expensive to buy than that which suffices for the 'water to carbide' generator. But where the system involves carbide discharging into water, the gas supply may be turned off or on with much greater freedom.

For kinematograph purposes, the acetylene jet may consist of three or four "Beta" Bray burners arranged with suitable attachment to the lantern tray. Preferably, each burner should have its own controlling tap, and the better class acetylene jets are

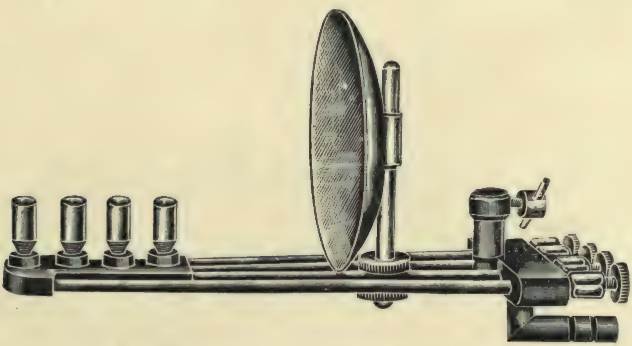


FIG. 153. FOUR-BURNER ACETYLENE GAS JET.

thus provided. A reflector completes the arrangement, and unless the light is skilfully managed, this same reflector may, and probably will give a lot of trouble in the way of unequal illumination effects upon the screen.

Acetylene projection in kinematography generally takes about one pound or a little more than one pound of carbide per hour for a four-burner jet. Taking the retail price of a pound of best carbide as sold in tins at the cycle shops at 6d., we shall see that acetylene, while giving a vastly inferior light to oxy-hydrogen, is also very

much cheaper—roughly six times. This is not reckoning light for light, but merely putting the actual cost of an hour's run of the one form of illuminant against an hour's run of the other. Small wonder then if the hard-up amateur decides to content himself with a diminutive two foot acetylene show in lieu of the more pretentious one possible with limelight. Acetylene gives a light of about 250 candle power, 300 candle power is the outside limit.

Incandescent Gas. Spirit. Oil.

Neither of the above forms of illuminant give a candle power exceeding for practical purposes, 150. The only one of the three which touches so high a figure as that named is the form of projection lamp in which an incandescent gas mantle is made to glow in the flame of vaporised methylated spirit mixed with air, fed to it under pressure from a hand air pump. Incandescent gas, as adapted to projection, even at its best rarely touches 100 candle power, while the best oil lamps such as may give an effective 100 to 150 candle power in the case of still view work are not feasible even for amateur kinematography on account of the abnormally large light source involved, with the attendant difficulty of concentrating anything like the whole of the emerging rays upon the gate.

Those who wish to find out more concerning these totally inadequate lighting systems, may therefore be referred to works on still view projection and on photographic enlargement making, for which purposes alone they are fitted.

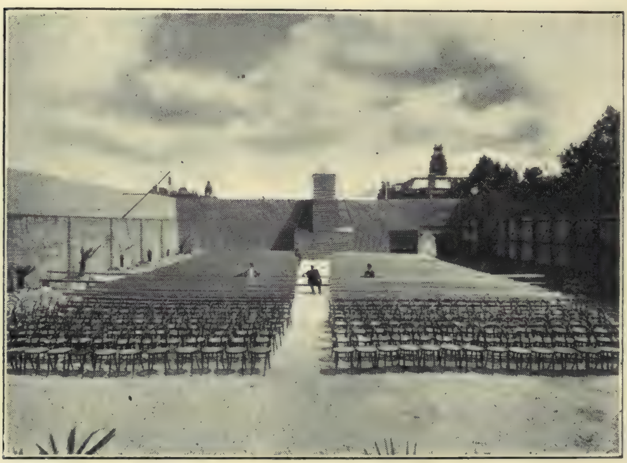


Fig. 154. An Australian Open-Air Show.

CHAPTER VI.

IN THE OPERATING BOX.

The operating box of a modern picture theatre should be a substantially built brick chamber provided with fireproof—preferably concrete—floor. It must allow sufficient elbow room for the operator and his assistant to get about freely between the projector or projectors and winding and film storage benches situate around the sides of the chamber. The winding bench will, as its name implies, have screwed to it or otherwise made firm upon it, a film winder, the best kind of winders being those in which two separate uprights carry respectively the full and empty spools, thus allowing of a good expanse of film between the two for purposes of examination while in passage from the one spool to the other. The same table will also be of sufficient size for the convenient accommodation of the pile of empty spools necessary to the conduct of the exhibition, while the full ones will be kept in one of the specially constructed metal cases, well away from where hot carbons—or limes, in the case of lime-light—may chance to be dropped or thrown.

One half of the second table or bench in the operating room forms a handy place for the reception of boxes containing song slides, announcement slides, title slides, etc., while the opposite half of it, divided off by a ridge, serves for such indispensable tools as electrical pliers, box containing bioscope spares and renewals, and also for fuse wire reels. The winding table accommodates the film mender and mending appliances including scissors, sharp knife, film cement, brush and duster. Beyond the items already enumerated, place also has to be found among the tools and spares for lubricating oil and oilers, cleaning brushes and dusters, and such like necessary odds and ends of the operating box. But when all these necessaries have been accounted for, there comes in a further and no less important point from the view of efficient operating. This is to see that no litter of unnecessary trifles, beyond those enumerated, or rubbish is allowed to accumulate on the operating box floor and under the benches. Numerous shelves are likewise out of place in the operating box, though it is a very neat plan to have hooks or nails for the accommodation of such tools as can be readily hung up, instead of allowing them to lie about when not in use.

A box or tray for the reception of new and used carbons, both for the kinematograph and announcement lantern is necessary in the case of electric shows. This should be fireproof or lined with fireproof material, and should also be compartmented so as to allow of the various sizes and descriptions of carbons being got at at a moment's notice. Red hot stumps will be thrown into the waste compartment.

SOME OPERATING BOX REQUISITES.

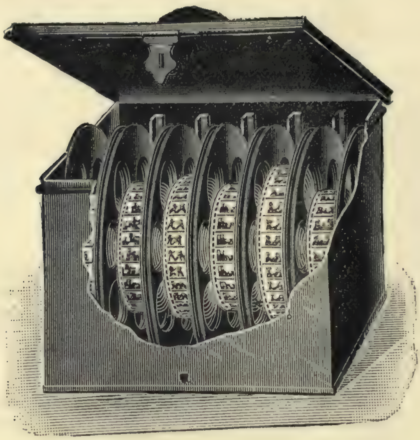


FIG. 155. METAL FILM SPOOL STORAGE CASE.

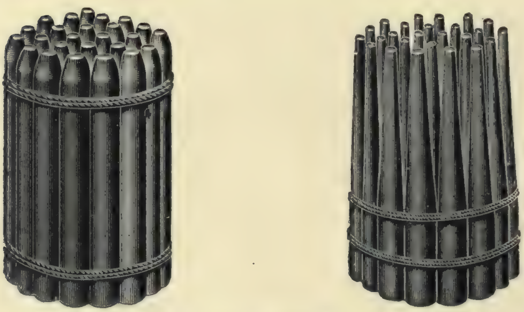


FIG. 156. CARBONS.

FIG. 157. SPARE CONDENSER LENSES.

In the case of limelight shows, an old tin into which to throw the used and cracked limes will answer all practical purposes. All benches inside the operating box should be composed of, or covered with, fire-proof material. Latterly the trend of licensing authorities is to eliminate as far as possible every speck of wood and such like combustible matter from the box equipment, so that where new boxes are being put up it will probably not only be best, but also cheaper in the end to be done with makeshifts.

In the case of a lime show, a good place for the cylinders is to have them tied on to the iron projector stand—either that, or they may be accommodated in proper cylinder stands fixed permanently near to the lamp house of the projector. With electric shows, the metal conduit leading the mains into the box goes first to the enclosed double pole main switch controlling the entire operating box circuit. From here, the current, after flowing through enclosed main fuses, placed on either pole, passes on to the variable resistance and the sub-circuits for incandescent lighting, the latter being branched off on the live side of the resistance frame. All sub-circuits must be provided with their own individual switches and double pole fuses. The conduit leading from the variable resistance (which latter must be well protected and right out of the way of the celluloid film used in projection) mounts up the side to the top of the box, where the leads issue from it, and falls directly to the terminals of the arc. Asbestos braiding is here a necessity. A similar arrangement of the smaller leads supplying the announcement lantern completes our projection current supply.

As to the sub-circuits mentioned above, there may be several, of which one may control stage lights, footlights and battens, should these be installed in the electric theatre in connection with incidental turns, song slide work, lecturing, etc. A further sub-circuit will control the lights in the auditorium, which go up and down between the showing of pictures. But here it is necessary to insist that where the latter arrangement is made, a second hall lighting circuit be also provided, controlled from the pay box or vestibule. Sometimes the theatre will be arranged so that the bright lights in the auditorium are on the operating box circuit, while a dull red glow from obscured secondary electric bulbs, which are never extinguished, even during showing, comes straight off the mains independent of any control, save that in the pay box. The reason for such an arrangement, as also for similar independent illumination of the exit signs, is to prevent the possibility of the audience being plunged in complete darkness, which might otherwise happen through an accident in the box causing the operator to pull his main in a hurry.

Having now roughly sketched the electric system of a picture theatre from the operator's point of view, we will pass on to consider matters connected with the art of showing.

Firstly, when film consignments arrive from the renting houses, it should be insisted that the operator unpacks them outside the

SOME OPERATING BOX REQUISITES.

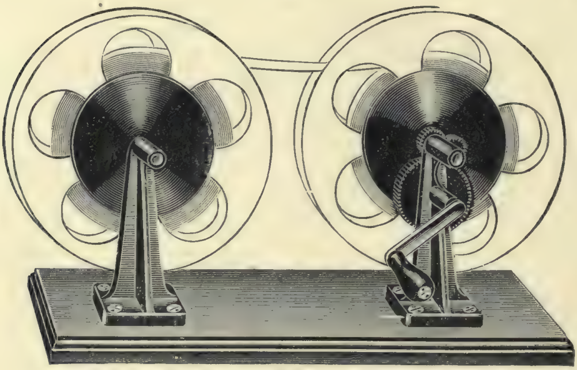


FIG. 158. FILM WINDER (APPROVED PATTERN).

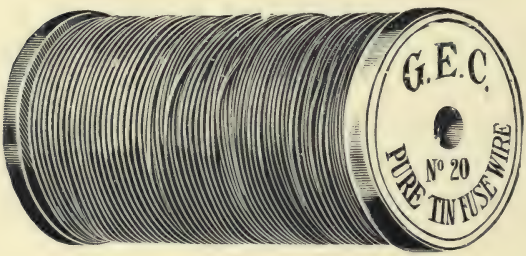


FIG. 159. FUSE WIRE.

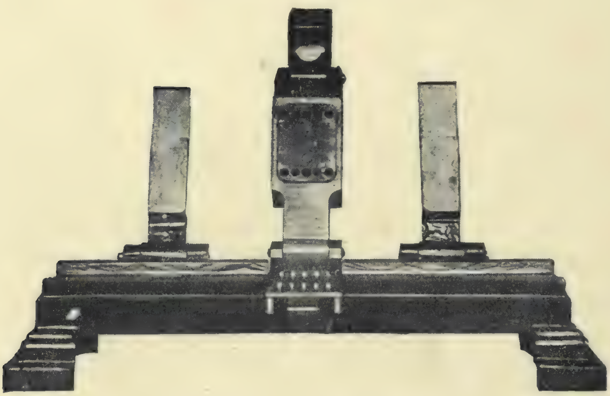


FIG. 160. FILM MENDER.

operating chamber. The films are too often done up with more or less of a litter of odds and ends of paper. Even promiscuous shavings from short lengths of old and worn out spacing are by no means always absent. A little of this sort of stuff getting about where a red-hot carbon stump might conceivably fall might well be the cause of incalculable damage. Make a rule, therefore, that packing and unpacking of films are not to be done in the operating chamber.

There is another class of work which should also have a place assigned to it as far as possible away from the box. This is the class of job connected with repairing of the projector fittings and of the arc. Some minor repairs and most adjustments, as also the cleaning of the projector are inseparable from the operating chamber. Here the best thing that can be done is to try and see that the one engaged upon the job uses clean dusters, brushes, etc., and that he shakes them out each time after use, and well away from the operating room. But when it comes to the use of the file and such like more daring repairs executed in the box, the risk to working parts of the mechanism, to say nothing of risk to the travelling film, through grit getting in the gate, becomes too serious to be tolerated. A repairing bench should accordingly be provided for the operator whenever possible right away from the projection chamber. If this bench is fitted with a few decent tools, such as tap and dies, small hand drill, small turning lathe, even of the most meagre description, together with an assortment of files, pliers, and screwdrivers of reasonably varied sizes and characteristics, there can be no question a good mechanic will do wonders in the way of keeping the projector running sweetly and of prolonging its working life. On the other hand a bad worker will never be able to resist experimenting with that concerning which he knows nothing. If, therefore, your operator or operators are not absolutely up to snuff, discourage all attempts by them at repairing on the grander scale. It will pay you better to buy a spare projector right away, so that you can send the old one off to be refurbished by the makers on the first signs of approaching senility and decrepitude.

Cleaning the Projector.

Next to the glasses of the optical system, the parts of a projector which require most frequent and most careful cleaning are the gate mask and gate runners. In the case of a dog machine, the sprockets of the lower or take-up sprocket wheel are also of the utmost importance. However, the gate is best left till last when cleaning a projector throughout, so we will get to work systematically on the machine as a whole.

The first thing to be seen to will be the lamp house. Remove the arc or lime jet, and take it with its attendant mess of carbon and silicate dust, or lime ash, right out of the operating box. Proceed to dust the lamp house carefully, and without stirring more than necessary the debris into the air. Remove the cell holding the

condenser lenses and place on the winding table for cleaning before returning the illuminant source to its place.

Having now got the lamp house clean we go on to the mechanism. If this is in a passable state it will be sufficient to first thoroughly brush the cogs of the gear wheels so as to remove collected dust and oil blobs. Next oil the wheels with clock oil and turn the mechanism. Of course, it will be understood that during these cleaning operations there is no film threaded in the gate. Also it will be wise, at the start to remove the objective lens from its jacket and place it with the condenser out of harm's way.

If, on turning the mechanism, it runs smoothly with no shake, and no jar or 'grind' in the wheels, then we may leave it at that as far a the cogs are concerned. If, however, shake or grind manifest themselves, the thing to do is to wipe off as much as possible of the surplus clock oil and anoint the cogs with vaseline, alternately applying it and turning the projector handle till it works its way well into them. This is a wonderful treatment for grind. Careful wiping of the spindles with liberal oiling of the oil holes in the bushings and subsequent cleaning up of all surplus which may exude, completes the treatment of well kept gear wheels. Sprocket wheels are polished up like door knockers, collected cakes of oil and dust around the sprockets being first rubbed away by means of the cleaning brush, or by gentle removal with a paper knife.

Where the gear wheels and pinions show signs of being clogged with collected muddy-looking cakey matter—which condition of things is pretty constant where the film service is cheap and consequently the films run old and dirty—there will be nothing for it but to take out the screws binding gear wheels and pinions together and remove both for thorough burnishing and internal oiling.

Take a clean oily rag and thread it through the holes from which shaftings have been removed for cleaning purposes. Pull the rag backwards and forwards till the bushing is thoroughly bright and lubricated. The polished pinion shaft may now be returned to place, when it should work easily and give no more trouble.

When a machine gets into the condition known as 'running hard,' and which condition is baffling to many operators, it is really a sign the time has come for such thorough internal cleaning and burnishing of bearings.

To clean the gate runners, also the gate and lens tube, usually entails no more than their removal, dusting and burnishing with a chamois leather. The rim of the gate mask must be gone over very carefully to take away all trace of the furred edge which from time to time gets to show on the projected picture. Gate runners and springs are of several different models. In some of the older fashioned and cheaper ones, the two are combined, the runners being in themselves flattened spring surfaces. Such are usually referred to as 'bow springs.' Gates fitted with these usually give trouble sooner or later. A spare back plate with bow springs attached must always

be kept handy with such gates, for when in use the thin steel bows rapidly wear down and snap. The broken ends are then in condition to rip off the film perforations till further orders, in other words till the evil attracts attention, and the new plate and bow springs can be slipped in place of the old and worn-out set.

Modern forms of gate are fitted with comparatively heavy rigid polished runners, which serve to keep the film close against the film mask, these runners or 'skates' being backed by separate adjustable tension springs bearing against their outer surfaces. Gate tension may here be adjusted to suit the requirements of any individual film, whether it be new or one worn and thin in the perforations. This system is far better than the old one of bow springs with their unalterable tension. Gate runners, however, require careful cleaning, both in themselves and as to the grooves in which they lie. Otherwise they may get stiff and fail to transmit to the film the spring tension behind them.

When cleaning the gate, start by polishing with a duster. Should any old gelatine from the films have caked upon the film track and be difficult to remove, it may be scraped off by means of a metal scraper having a straight semi-sharp edge, and being of not quite the width of the gate track. A penny will also serve the same purpose in most cases, its edge, though round, having just about the required amount of bite upon the gate. Personally, the writer uses neither. He discovered for himself some time ago the advantages of a piece of ordinary typing eraser. This, besides most thoroughly cleaning the gate and runners of all suspicion of accumulated film coating, serves at the same time to burnish the metal, thus making one job of what would otherwise be two separate operations.

After cleaning the gate, wipe it over with a very slightly oiled rag. More than a mere suspicion of oil is not permissible.

The dog roller of a dog machine is also very liable to collect about it waste matter from much used film subjects. This waste material prevents its rotating freely, and later on it will work into the dog spindle and spoil the snugness of the bearing, and consequently much of the steadiness of the machine. With Maltese cross machines, the intermittent sprocket must be kept equally clean. The oil bath must also be kept filled, while now and then the old oil should be completely run off and a new supply substituted.

Occasionally—as for instance, when the shaft spindles of projectors have been removed from their bearings and replaced after cleaning—it will be found that the synchronisation of the cover position of the rotary light shutter with the picture change has been interfered with. Here it will be necessary to re-adjust the covering shutter, except in those rare cases where this part is non-adjustable. Then the still more arduous operation of fitting the picture change to the light shutter becomes inevitable. The former adjustment, however, is by no means difficult.

Thread a piece of positive film in the projector gate, as for showing. Now place yourself with the eye looking straight into the projector lens at the threaded positive film. Turn the projector handle very slowly until a shift of the film in the gate warns of the excapement coming into operation, then proceed to set the light-cut-off so that at the moment this movement of the film starts the cover sector justs completely covers the lens. Continue turning till the covering sector of the shutter clears the lens again, and if adjustment has been correctly made the eye will just miss seeing the last trace of the picture shift in the same way that it grazed the beginning of the movement. There are besides this simple method, several mathematical ways of measuring the middle point of the picture shift and setting the cover shutter accordingly, but in practice the one given above is at least as simple and also far more certain. One point must be borne in mind. When adjusting the light cut-off upon a projector fitted with rackwork masking to the gate, see first of all that the gate rack is in its central position. Where the masking of the film is effected by means of a jockey roller riding upon the film between the gate and escapement, as in some types of projectors, no precaution as to the mask setting is necessary.

The machine being now well cleaned in all its metal parts, there only remains to polish the glasses of objective and condenser before fitting them back in their places. Instructions for cleaning and replacing the objective elements have already been given earlier in this part. The condenser lenses are easy enough to replace, since in the case of triple and Herschel condensers the fittings usually only allow of the right glass being dropped into the right position, always remembering that the concave side of the meniscus (smaller) lens must be toward the illuminant.

Plano convex condensers consist of two identical plano convex lenses, placed in a cell with their flat sides outward. Such condensers are not much used in kinematography, but where met with the replacement of the glasses after cleaning is easier still, since both being identical one cannot well go wrong. Selvyt cloth kept scrupulously clean and for the one purpose only will be found excellent for wiping over the optical glasses of the projector.

We now come to centring and adjusting the projection light ready for showing. To do this, first turn on the current into the arc and strike carbons, or light up the mixed gases and adjust lime, in the case of limelight. The light source is now to be considered as back once again in the projector's lamphouse. Leave the gate unthreaded. The sliding light cut off, as well as the rotary light shutter, must, further, be out of the way, so that as soon as correct illumination has been obtained, it will be seen in the form of an evenly illuminated picture disc upon the projection screen. Notice at first whether the light beam streaming through the condenser strikes any part of the gate, or if not, where it does go ; up, down, or one sided, or both. The object will be to get the light shining in a neat even pencil just sufficiently large to cover to the corners of the aperture of the mask, and illuminate the

projection disc equally all over. If now the light beam strikes too high, lower it by raising the illuminant source; if the light strikes too low, bring it up by reversing the above process. Similarly, a left hand turn to the source of illumination will switch the light beam to the right, and *vice versa*. Sooner or later we cannot help getting the light, such as it is, to strike into the gate aperture. But this is not to say the effect will be right. Perhaps, instead of a compact bundle of rays about the diameter of a five shilling piece or less, there will be a large and correspondingly dimly illuminated area widely overlapping the gate. This will mean that the light source is too near the condenser. Pull the arc or lime jet bodily backwards as though sliding it out of the lamp house, and the light pencil will come together till it is as it should be. On the other hand, the light, on first centring, may show a curious bluish cruciform effect upon the centre of the gate. Where this manifests itself, it means the light source is already too far from the condenser. The remedy is to shift it nearer up by pushing the lamp bodily forwards further into the lamp house.

Even now, unless the front of the condenser is the right distance from the gate, the light on the screen will not be even, but will exhibit a more or less circular or zonal gradation of colour and brilliance. Where such effect shows itself, the lamp house itself must be shifted further back upon its runners, so as to increase the distance between condenser front and gate mask. From four to six inches is the usual separation required between the two with a four and a half inch condenser, though the individual characteristics of the condenser can alone determine the matter.

Making up Programs.

Before a picture program can be exhibited properly and without long and totally unnecessary gaps between the showing of the various photo-plays, it is necessary to subject the films to the process known as 'making up.' Making up consists in collecting together the films comprising the program, into groups of a length such as can be conveniently accommodated upon the several spools. Not only must the films be selected into aggregations totalling, say, 1,200 feet in each, so as to wind on the minimum number of spools, and consequently show with the minimum number of change intervals, but subjects must be arranged in such sequence that each one will, by contrast, help the next as much as possible.

Thus, suppose our film consignment has in it two Wild West films, each of 600 feet, it would still be very bad making up to join them together, although by doing so we should get our exact 1,200 feet spool length, for in this case it would mean that two similar subjects totally devoid of contrast would appear one after the other. A man who is good at make up understands the value of light and shade in the picture program. But this is a matter on which more may be said subsequently.

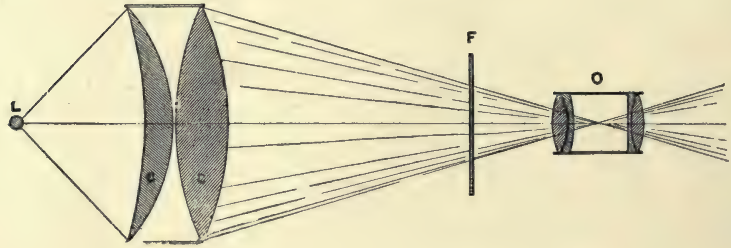


FIG. 161. A CORRECTLY CENTRED LIGHT BEAM.

L, light source. CC, the glasses of a Herschel condenser. F, projector gate, in which is cut a hole of suitable size for the picture mask. O, objective lens of the projector.

Note how the light beam is here adjusted, and try to centre it the same in your projector.

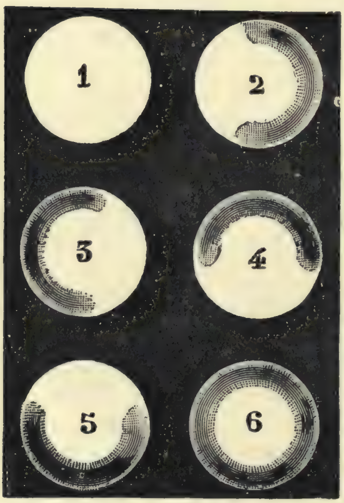


FIG. 162.

HOW WANT OF CENTRING OF THE LIGHT SHOWS ON THE SCREEN.

1.—Light correctly centred.

2.—Light source too much to left.

3.—Light source too much to right.

4.—Light source too low.

5.—Light source too high.

6.—Light source too far from condenser.

To make up a spool, the film which is to show last upon it is wound up backwards, and to its latter end is attached about a foot of blank spacing, either the white, black, or the blue variety. The film is then rewound right way on to the empty spool. Its title will come outermost after such winding. Affix to this title a foot of white blank spacing, and to the other end of it attach the latter end of the second film, and so on. When the last film the spool will accommodate has been wound upon it, a further 'threading up' length of blank spacing is attached, and the reel is ready for exhibition.

White blank spacing is obtainable from all film renting houses at a cheap rate. When splitting up the spool, or 'cleaning' the films off it for sending back to the renting house, the spacing is removed and retained for further use in making up the next film program.

To join film for the purpose of mending it or when attaching spacing, adopt the following routine. Cut an edge to be joined level with the top of a picture. Cut off the edge to be attached to it about one quarter of an inch or rather less below the bottom of the picture on the end of its length. Lick the portion of the picture last cut into so as to moisten the gelatine coating. Then lay film down, gelatine uppermost, and proceed to scrape away the coating from the licked flap, till clear celluloid only is left.

Dip a camel hair brush into a bottle of film cement and apply rather freely to the scraped flap, then press this flap down upon the celluloid side of the length to which it is to be joined. If rightly done both emulsion sides of film will look the same way. Shift the cemented flap rapidly into place so that the lowermost sprocket hole of the one length coincides with the uppermost on the other, and hold the two thicknesses of celluloid together for a couple of minutes. They will then be sufficiently stuck to adhere, and ten minutes more will make a tight joint of them.

A reliable formula for ordinary film cement consists of commercial Acetone and Amyl Acetate in equal parts. In this mixture allow to dissolve sufficent clean celluloid chips (old cleaned off film will do) to impart a slight degree of viscosity.

FORMULA FOR CEMENT FOR NON-FLAM FILM. Dissolve non-flam film base in chloroform till a viscous liquid results. Use in the same manner as ordinary cement, but bearing in mind that it evaporates quicker, so leaving less time for effecting registration of the sprocket holes.

Where the operator's skill in film joining is not too great, he may press in the services of a film mender. This inexpensive little accessory accomplishes the task of correctly superposing the sprocket holes upon the two lengths to be joined, and holding all in position till dry. It is a neat device but not necessary, and certainly not time saving, in comparison with the hand mending of a good operator.

Film breakages are doctored by cutting out the portion of celluloid which has been damaged and connecting together the nearest perfect pictures, in the foregoing way.

Putting Through.

This is the actual thing—the projection of the kinematograph picture itself. It is set about in the following way.

To load the upper spool box, open the door and place the ready made-up spool in position upon the central bobbin. Pass the film end through the slit between the spool box feed rollers. If projecting upon an opaque screen, which is now the almost universal practice, the emulsion side of the film must unwind towards the condenser. If it does not, it means that the spool has to be taken out and reversed, the inner side becoming outermost, and *vice versa*.

Pull down about three feet of film, which corresponds with the thread-up length, and close the spool box door after making sure that everything is running normally inside. Snap down the jockey roller from the upper feed sprocket, pass film between jockey and sprocket then snap jockey up into place again. The film between film box and upper sprocket wheel should be left fairly tight, that is to say, without any slack lopping over the lens and light shutter. Now open the gate and pass the film end into it, leaving about a six inch free loop between the gate top and upper sprocket feed. Pull the film well into its place in the gate track so that it lies both flat and even, and proceed to snap the runner plate into place. Try the film by pulling slightly on the film loop at top of gate. It should slip evenly, but with a gentle friction as the result of the pressure of the runners upon its edges.

Feed the film, which now lies free below the gate, over the jockey roller of the masking adjustment, if the machine is one of this kind, and round the dog of a dog machine or over the sprockets of the intermittent sprocket wheel in the case of a Maltese cross projector. The film next passes over the take-up or bottom sprocket in the same way as it was led over the top one, and from thence goes to the take-up spool (empty) within the bottom spool box. This take-up spool will have affixed to its hub a spring arrangement for gripping the film end. Wind the mechanism of the projector sufficiently to cause the take-up to pick up one complete turn of film. This ensures that nothing will fail to act, and with it threading is accomplished.

Adjustment of the light is presumed to have been made as described earlier in this chapter. There is still the adjustment of the gate mask, which has to be made before showing each picture. Make it thus.

For Rackwork Gate.

The shutter of the sliding light cut-off should have a very small pin hole pierced centrally in it. This will pass an equally small light pencil, almost devoid of heat and therefore harmless to the film. With this arrangement it will be possible to look through the lens and see for oneself if the masking is right, the sliding light shutter meanwhile remaining closed. Adjust the mask and everything will be ready for throwing the light cut-off out of the way and starting projection.

Another way of going to work is this : Paint the inside of the operating box safety shutter white, when it will be found that the pictures to be projected on the screen may be seen fairly distinctly upon this whitened dropped shutter flap as the result of the narrow pencil of light streaming through the pinhole of the closed light cut-off in front of the condenser. Such light would, however, not be sufficient to cause any visible image upon the comparatively distant projection screen. The image on the shutter is used to adjust the mask and also for centring the light, after which the shutter may be drawn up, the light cut-off opened, and projection proceed.

Fixed Gate with Jockey Roller Adjustment for Masking.

The difficulty of masking is here much greater, since with this system no adjustment is possible until the projector mechanism is actually at work. The best way is to start the projector slowly with sliding perforated light cut-off closed, and with the operating box shutter down. As an alternative to using the box shutter, the assistant operator may hold a white card well in front of the lens. While the projector is thus running dead slow, the jockey roller masking device may be brought into operation until adjustment is seen to be effected. The light cut-off is then opened, the card or shutter withdrawn from the track of the light beam, and projection proceeds as usual. It will be seen that masking in this way with short titles, there is the danger of their being lost. This may be overcome by joining to the front of such titles, other scrap film bearing an image or imprint of some sort and having the same masking. Adjustment is made upon the latter, and afterwards the cut-off is drawn out, and projection proceeds upon the title proper.

Dangers to be Guarded against in Operating.

Breakage of film, either through burst perforations, fault in the celluloid base, wear, or bad film joining, is bound to occur more or less often. Where such breakages take place in the gate, the film may stop dead in the track of the light beam. If the operator is not on the look-out to close the light cut-off instantly, the celluloid will certainly, under such circumstances, fire. Such firing should not spread if the gate is well designed. Still, the very fact of possible combustion of any part of the highly inflammable film is enough to warn the operator before-hand to be on the constant look-out all the while the film is going through.

After a break, and when the light has been cut off, the thing to do is to open the gate quickly, wind down enough film to carry it over the escapement, and proceed to pin the free end to the broken one for the purposes of taking up. Projection may then go on as before. Do not use large pins for the purpose, and try not to do more injury than necessary to the broken film ends. Every picture that can be saved on the edges of a break is so much more film length, with its representation of incident preserved.

Occasionally, portions of film perforations will split and stick in the gate in the middle of projecting. If such splinters do not spoil the effect of the picture on the screen, one need not stop till the end of the picture, since the moving celluloid between them and the light source acts as an effective cut-off to the heat rays. It is well, however, to increase the speed of projection considerably the moment any splinters make their appearance and to keep it up till the subject is over, when, of course, the light cut-off is at once thrown in, and the gate opened and cleaned.

Spooling Single Films for Projection.

Single films are sometimes required to be exhibited in a hurry and without winding previously on a regular film spool. In such cases, it is usual to spool the film on a split spool, but when wound tightly in the first place the hole in the centre of the wound film may not be sufficiently large to admit of the hub of the split spool going through. In such a case, which is figured in Fig. 163 C, the opening can be enlarged in the following manner. Take hold of the roll with the left hand as shown at D, Fig. 164, and then place the fore-finger of the

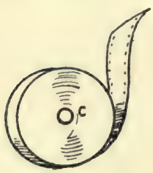


Fig. 163.

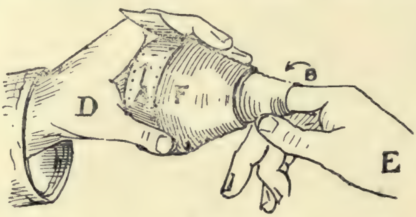


Fig. 164.

Fig. 165.

right hand in the centre of the roll, as shown. The roll may then be drawn out horizontally, forming a cone shaped mass, as indicated at F. Now grip with both hands, turning the left hand in the direction indicated by the arrow at A, and the right hand in the direction indicated by the arrow at B. If the larger end of the roll at A is allowed to slip through the fingers whilst the right hand forces the film from right to left, as shown by the arrow B, then it will be found that the roll is gradually increasing in size, and that the opening in the centre becomes enlarged, as shown in Fig. 165.

Joining Films.

Film ends are joined together by first cleaning the extremities as shown in Fig. 166, and then cementing the one on the other with film cement. The accompanying detailed and illustrated description may be of service to the novice.

Cut one end at the junction of the pictures, and the end of the film to be joined thereto three-sixteenths of an inch from the junction of the first picture. Take a rule as at C, Fig. 167, and place it over the film last mentioned, with the edge of the rule in such a position that a penknife E may be taken, and the gelatine scraped away, in a straight

line across the film in the direction of the arrow. There will now be a clear space of celluloid surface at A, Fig. 168. Now wet the fore-

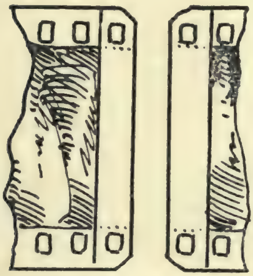


FIG. 166.

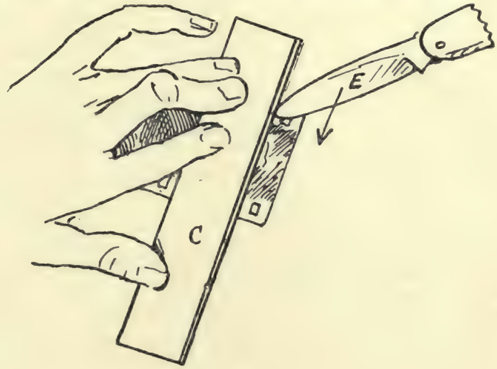


FIG. 167.

finger and moisten the remaining gelatine B. After a few seconds, this strip may be pulled from the celluloid support, so that there will be a piece of clear and clean celluloid at the end of the film measuring

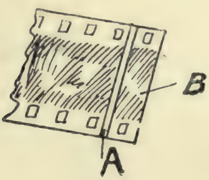


FIG. 168.

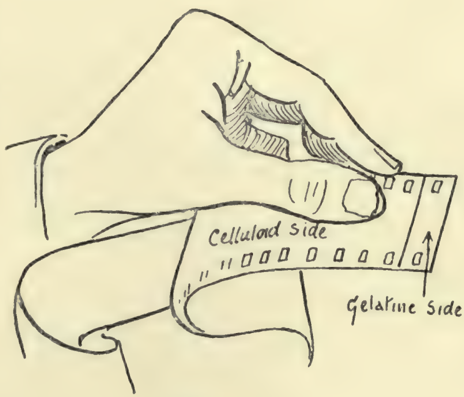


FIG. 169.

about three-sixteenths of an inch. Having cleaned and prepared the film, as shown in Fig. 169, cement is applied to the cleaned surface, the second film laid upon it with the sprocket holes in register, and the whole pressed together or put under pressure in a film mender till a strong join is effected, Fig. 170. It should be noticed that the film

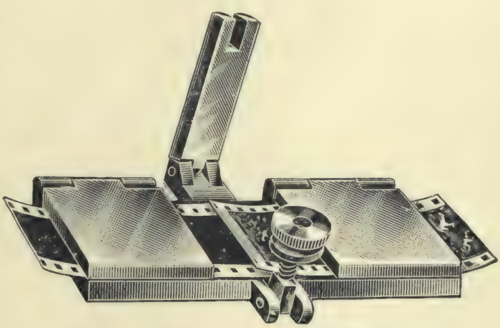


FIG. 170. THE FILM IN THE MENDER.

cut at the junction of the last picture is laid celluloid uppermost upon the film with the clear space extending, and the gelatine side upwards, as indicated in the cut. The gelatine, however, has been removed from this part, as already described.

Failing of the take-up is a very real danger to be faced when operating. This danger is, moreover, greatly increased by the necessity of using a lower as well as an upper spool box in compliance with Home Office regulations. If the film begins to pay out on the floor there is always a risk of its becoming ignited by a stray spark or red hot particle from the light source. An assistant in the box to rectify such a condition of things as sticking of the take-up spool by if necessary completing the winding by hand, is a very wise precautionary measure. If there is no second person handy when the take-up fails, then the operator must manage to hand wind and attend to the other parts of projection at the same time, and as best he can. It is at such moments as this that masking is liable to go wrong, and indeed such a reason should be about the only valid excuse for it doing so and remaining out of adjustment for any length of time. After the show, a faulty take-up is adjusted by tightening or renewing the spring clutch.

Orderly Showing.

The moment a film subject is concluded, the lights in the auditorium should be switched up, so that the audience may consult the program as to the synopsis of the next motion picture story. Meanwhile, the masking of the forthcoming title is adjusted and the illuminant looked to. When all this is satisfactorily managed, the auditorium lights once more go down, the light cut-off of the projector is opened, and projection proceeds again.

As the spool of film becomes nearly exhausted, the attendant's business is to fetch a new one ready for instant threading and to open the film box doors. The moment the last subject on the spool comes to its end and the cut-off is thrown in, the auditorium lights go up and the operator quickly whisks the empty top spool from its place, and replaces it with the new full one, proceeding to thread up without delay. Meanwhile, the assistant removes the loaded take-up and transfers it to the dead arm of the rewinder, returning immediately to place the empty reel from the top box in position in the lower spool box, where it will now act as the new take-up spool.

While the operator completes threading, the assistant may commence rewinding the former spool on the rewinder, or he may stand by the projector holding the adjustment card in front of the lens, etc., until the signal is given for the auditorium lights once more to go down, and projection of the second spool commences.

It is possible for an operator to do all the above single-handed, but in such cases the light and masking of the projected image usually suffer while his back is turned attending to the rewinding of films for the next show. The latter remark refers only to motor-driven shows, which only lend themselves to one man control.

MOTOR DRIVEN PROJECTORS.

Many projectors are now motor instead of hand driven. Motors for such a purpose are almost invariably of the direct current type, developing a horse power of from the one sixteenth to the one sixth, and being of the shunt type, in which the speed is variable and controlled

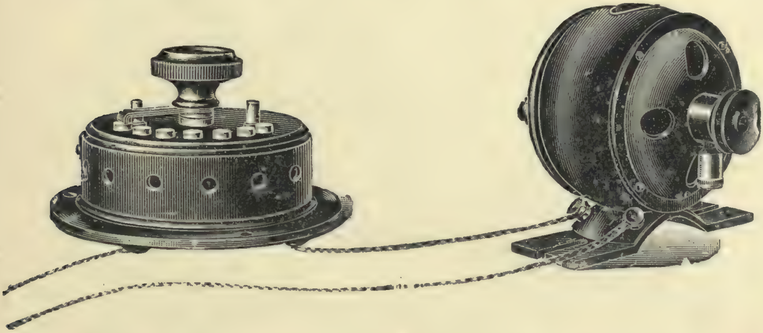


FIG. 171. BUTCHER'S MOTOR FOR DRIVING PROJECTOR.

by a multiple point rheostat, or shunt regulator. Fig. 171 gives the method of connecting such a motor with the electric supply taken as a sub-circuit off the dead end of the main operating box switch. To start up motor, put in switch and turn rheostat handle till the required speed is attained. The rheostat is conveniently bolted to the side or end of the projector stand, so as to be controlled by means of the left hand while masking and other adjstments are made with the right.

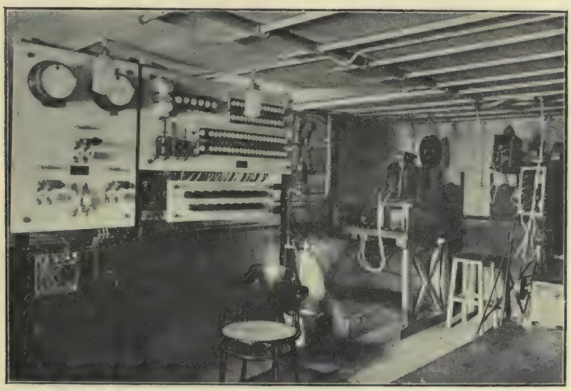


FIG. 172. A ROOMY CONTINENTAL OPERATING BOX.

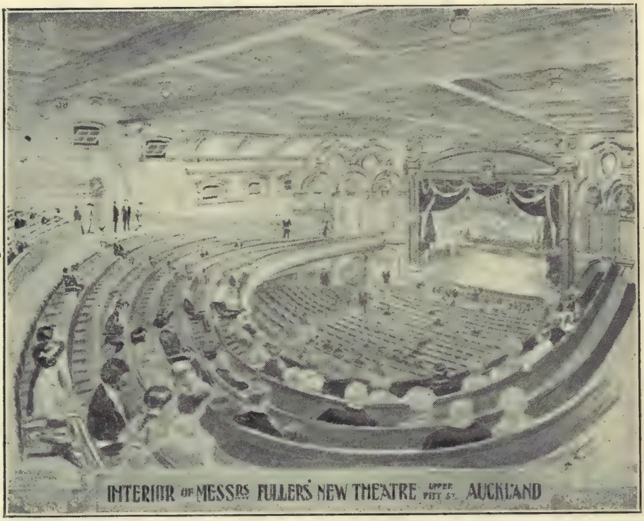


FIG. 173. UP-TO-DATE KINEMATOGRAPH THEATRE IN NEW ZEALAND.

FIG. 174. AN AUSTRALIAN TOURING COMPANY.

PART III.

PART III.

CHAPTER I.

ON ACTING BEFORE THE KINEMATOGRAPH.

BY

MR. HENRY MORRELL, OF HIS MAJESTY'S THEATRE, HAYMARKET.
(*Sir Herbert Beerbohm Tree's Company.*)

The more I have thought—the more I have tried to give you something intelligible on the subject of acting before the kinematograph—the more conscious have I become of the difficulty of my task.

I could not write a chapter on how to act! A book would not teach a man that. I may be able to write a few remarks on how to adapt stage acting to the requirements of the camera, though much of what I say on this head seems after all only what would occur to an actor of experience as readily as the way to remove ink-stains would suggest itself to an experienced chemist. But how to give help to the promising novice, that is the real difficulty I am now to try and face.

So many books have been published on "How to become an actor," "How to comport oneself like a gentleman on the stage" (1d.), etc., etc., that I feel rather guilty lest anything written by me may seem like an attempt to add to the number. Let it be hoped that in what follows I shall come rather nearer than that in my effort to be of use to the would-be dumb show artist. And with this I will pass on to the subject in hand.

It has always been a matter of regret amongst men and women engaged upon such evanescent acts as singing, playing upon the piano, or the violin, and acting on the stage, that the results of years of patient and close application should be destined to perish at the very moment of their birth.

True, an impression may live in the memory, but in being handed down it becomes considerably changed, for better or worse, until at length a very hazy and imperfect idea remains of what originally was.

And this is not to the artist, at all events, a very satisfactory state of affairs. The image which we conjure up of the past is the product of a number of psychic factors. It results in part from the impressions we receive from those to whom we have listened, or whose writings we have read.

But these impressions, we must remember, bear a stamp of the individuality of the person through whom they have come. They represent only his personal view ; so that, however good the writer, he offers an incomplete picture of his subject, limited by the standpoint from which he has seen it. Limited, that is, by the bias of his own taste and judgment. One has but to compare a criticism of a play with one's own impressions upon seeing it, to realise how great this difference can sometimes be. So, I am sure, it is with our idea of the great actors of the past.

Future Possibilities to the Actor.

If it were possible to see Edmund Keen or David Garrick, we should probably find them vastly different from what we had imagined. Not that I think we should be disappointed. I firmly believe those elements in their work of perennial human interest, the depth and sincerity of their passion, the truth of their emotion, would be as moving as ever.

But we might find some difficulty in dissociating them from the style in which they would be presented. Unhappily, that IF is an infinitely large one. To our eyes, the panorama of the past is hidden. We shall never see it. But posterity is destined to be more fortunate. The kinematograph will bring the past before it, and it will be able to look back, across centuries, maybe, to the distant present.

It will be able to judge with its own eyes of the past . . . of the great actors of to-day . . . . . though still somewhat imperfectly perhaps, for that elusive element in a man's success—his personality —makes no appeal from the photographic screen.

But that may come.

One could assign no limit to human ingenuity in face of the progress of science during the past sixty years.

Well, here is comfort for the neglected genius whom the world to-day refuses to recognise. He can appeal to the wider jury of time—if he is lucky enough, that is.

This is our aspect of kinematography, of interest to the actor. But I am not sure it is of so much interest to the film makers.

The latter, whilst appreciating the actor's desire to be alive a hundred years hence, might well wonder in what way the returns then are going to benefit him to-day. And there is still this difficulty for those who desire to go down to posterity : They must be sufficiently popular to pay for their taking.

But there is another side : The art of acting applied to the kinematograph. Here is a field in which actor and film maker are interested equally.

The kinematograph as a form of entertainment has come to stay. It offers so many possibilities at once amusing and instructive that its future is, without doubt, in every way assured. And perhaps its most popular appeal is with the kinematograph play. So great is the demand for this now, one might safely say there is not an hour of the day or night, but that somewhere dozens of comedies or dramas, farces, melodramas and plays are being exhibited upon the screen.

With its growing popularity, more and more attention will be concentrated upon its various factors, and one in particular, the question of adapting stage acting to the requirements of the camera, must come in for especial consideration.

Now, in order to gain a clear notion of kinematograph acting, it will be best, perhaps, to make an analysis of the methods of stage acting, and observe in what respect thay need adapting to the requirements of the camera.

We have on the stage three modes of expression, viz.:—

1. Voice,
2. Gesture,
3. Facial expression.

Action, which is a combination of these, is the medium with which the actor works. Of these modes of expression, by far the most important is the voice. Indeed, this organ is capable of infinite expression, for not only does it convey in words a definite train of ideas to the minds of the audience and so, by a psychic process on their part, make its appeal but by proper modulation it can be made to express every emotion that we are capable of feeling. And this to a degree which depends upon the actor's genius.

A line which to all appearances might be quite commonplace, suddenly becomes electrified by the personality of the man or woman whose whole being vibrates in the expression given to the words. Since, then, in kinematograph acting, we are deprived of the use of the voice, every other available means of expression must be used in an enhanced degree to make up for the loss. We must convey through gesture and facial expression the whole movement of the play. This is by no means an easy business. Indeed, it is a high tribute to an actor to have succeeded in holding an audience for any length of time by the sole use of pantomime.

Gestures.

In the old days, both in England and on the Continent, gesture was recognised as an exceedingly important factor of expression. and it received accordingly a good deal of attention. Those were the days of Drama, Melodrama, and Farce. Many so-called authorities however, approached their subject from anything but a scientific point of view, with the result that much that was accepted as good gesture was in reality clumsy and artificial.

It was left to M. del Santo to found the school which to-day enjoys universal acceptance.

This man was a pioneer in the science of psychology, and his methods are founded upon accurate observations and extensive experiment. They can be used in every type of play—it is merely a question of adjusting breadth to circumstance.

In modern plays the gesture is obviously somewhat curtailed in England, at all events, because it is not in the nature of Englishman to use much gesture. In the classic play, on the other hand, gesture plays a more important part, and finally, in the kinematograph play, it has the chief part.

The kinematograph actor will need, therefore, to be above all things, an accomplished pantomimist. He will also need to have a very expressive face. There will then remain only the circumstance of adapting his skill to the requirements of the picture screen.

The Requirements of the Kinematograph.

Now in acting before the kinematograph, there are one or two important points to be borne in mind. In the first place, it must be remembered that although the photographic plate is, under certain conditions, a perfect rendering medium, the swiftness of movement and general defects attendant upon the reproduction of living pictures render the latter more or less insensitive to minute detail.

For this reason it would be a mistake to strive for subtlety of effect. Even on the stage, and especially in large theatres, much of the actor's finest work is lost to the audience. So much that can be conveyed in a look or compressed into a whisper is lost immediately these are exaggerated to carry to distant parts of the house. Now, in acting before the kinematograph, all this applies very much more. It is therefore necessary to adopt a style which shall be impressionistic rather than otherwise; a style wherein effects are obtained by methods at once broad, deliberate and incisive. One should, besides, act a little more slowly than on the stage; this gives the film a better chance of taking the impression. On being reproduced, it can be quickened again to whatever speed is required.

Besides the actor, the playright is called upon to adapt his act, for the dramatic possibilities of the kinematograph plot are limited by the resources of the camera. A play that is built up of intuitions requiring a lot of words to interpret them is out of its element on the picture screen.

Each situation should carry no more words than are necessary to suggest the pantomime that will convey the dramatic movement of the scene.

The subject should be preferably of the strong and gripping order. This will stir up the audience to a high degree of interest that will carry them over any moments that might not be quite clear to them in meaning.

The chief point to remember then, is to write for pantomime, and in producing to point out to the actors the spirit to be conveyed; to pick out, as it were, the essential idea, and interpret it in pantomime, all other language being merely incidental and of no vital interest to the story.

This is the ideal form of kinematograph play. Often, of course, a certain interest prompts a film maker to photograph a stage play, when the scenes most full of movement are usually chosen, but this is not by any means a satisfactory kind of entertainment on the kinematograph. The play was intended for stage representation, and its general movement to be interpreted with the aid of the voice, what gestures there would be being accidental or accessory, rather than playing the vital part in the general interpretation of the dramatist's work.

Nor is it easy, nor satisfactory, except in those cases where the subject lends itself especially well, to adapt this style of play to the kinematograph. Rather does it require a special play—the pantomime play—written for the kinematograph stage.

Of late an attempt has been made to use the gramophone in conjunction with living pictures, but without results that are quite satisfactory. In time, however, there is no doubt this question will be solved. Then matters will be a good deal simplified, but at present, the kinematograph actor must be a master pantomimist, and the writer of kinematograph plays must write for pantomime.

FIG. 175. CURIOUS ACTORS FOR THE KINEMATOGRAPH.

CHAPTER II.

PLAYING TO PICTURES AND EFFECTS.

By A. E. Taylor.

Whilst it has been repeatedly said that it is the pictures the people come to see, it must always be borne in mind that the electric theatre patrons like their pictures not neat, but diluted with a little music.

This corollary to the pictures may be of two kinds, instrumental, that is to say, pianistic, or orchestral, by means of a band or orches-matic orchestrion. There are, however, at the present time, very few theatres employing orchestras.

Where a piano is used, it is advisable to sink the instrument in a well close to the picture. Have the player sit where the screen is clearly visible, but if a piano light has to be used, be sure it does not shine into the eyes of those in the front rows. If your house is semi-lighted, the piano light will not be needed.

Do not expect your pianist, however clever he may be, to make good music with a poor piano. A second hand instrument in good condition from a reputable maker is greatly to be preferred to the gaudy new fraud that is made up solely to sell. A baby grand takes up a lot of room compared with an upright, but it yields a splendid return. An organ can be used with good effect, either in combination or by itself.

Pictures can, of course, be played to by an orchestra, but to do so properly, it is necessary to have the very best talent. It is an impossibility to gain results by engaging inferior talent. As a rule, the majority of managers take the responsibility on their shoulders of engaging musicians and the chances are that not one in fifty has the least conception of what is required.

Where an orchestra is to be employed, always leave the choice of musicians to the leader. If he is capable of leading an orchestra, most assuredly he is capable of selecting his musicians. The whole responsibility is on his shoulders of having the music rendered in the proper manner. If he has an inferior class of performer who only murders the music, he is the one who is ridiculed.

But no matter what form of music you employ, you will find that motion pictures cannot be played without a proper repertoire of incidental music. This class of music is an absolute necessity, and can be used for any situation. There is, for example, hurry music of every description that can be used for fights, Indian attacks, duels, sword fights, etc. Sentimental music for death scenes, despair,

sadness, meditation, and special music for military, comic, love, exotic, racing, and the hundred other scenes too numerous to mention.

And what sounds more encouraging to a manager than to hear his patrons complimenting him on the fine orchestra or the capable pianist he maintains, and the excellent manner the pictures are played. When the public begins to talk in this way, you may rest assured that you are giving satisfaction, and satisfaction is what brings your profits each week.

Then too there are now the singing pictures, which employ what are commonly designated talking machines, and which require a constant supply of discs to supply the words and music for the songs and operas illustrated. No picture theatre can be said to be thoroughly equipped that does not possess one of these mechanical sound producers. In many places it is found wise to introduce one or two vocal or instrumental solos, but the practice should only be adopted by the manager who is able to afford really good talent. Fifth or sixth rate variety turns do more harm than good, but real concert artistes lend tone to a picture theatre, as has been proved over and over again at the shows run by Mr. T. J. West, Mr. Dove Paterson, and other leading *entrepreneurs*.

There is, of course, a variety of choice for the musician to draw upon, but up to the present there has been no real attempt on the part of music publishers in this country to collate in one or more volumes a selection of music which would meet the requirements of picture players. In America, however, much has been done in this way, and there the latest acquisition to the music market is a volume containing over one hundred numbers of descriptive music used in the presentation of motion pictures, Prof Gregg Frelinger being the composer. There is also a specially written volume of music for cinemas by M. Smyth of Paris. The music is especially selected and can be adapted to any scene shown in motion pictures. The numbers range from comic to sad, and changes in the rendition are unnoticeable, harmony prevailing throughout. Characters and scenes alike are represented in the volume. Some of the characters and scenes described in notes and bars by the composer are an aged coloured man, aged persons, antique dance, powwows, religious scenes, reminiscences, repose, sneaky music, spectral music, soldiers in camp, weird pantomime, drum and fife imitation, and many others.

For effects, such as the clattering of horses' hoofs, the noise of falling or running water, smashing of crockery, railway trains, and the thousand and one things seen on the screen, there are all kinds of appliances and effects machines, and the proprietor who wishes to make the silent drama as realistic as possible, must invest in one or other of these.

Music for kinematograph shows is somewhat outside the purlieus of this book, and space will not allow full justice to be done here to the subject. Readers desiring full information on this important

adjunct to the picture show should obtain "Playing to Pictures," by W. Tyacke George, and produced by the same publishers as this book. Here will be found sections on the Musician, Music Arrangements, Classifying the Picture, Music to Prevent Panics, The Art of Improvising, How to Produce Effects, Music Licenses and How to Obtain Them, Musicians' Salaries, How to Choose a Piano, Small Bands, Making up Programs, Musical Copyright, List of Music Publishers, List of Specially Written Music, A Suggested List of Appropriate Music, List of Popular Songs, etc., etc.

We have recently seen in Paris a new type of instrument for producing every conceivable sound in the most realistic manner and when performed upon by an experienced man in conjunction with the pictures it seems impossible to believe that it is not the actual thing we are viewing. It is worked with a keyboard and is electrically driven and controlled. Over 300 various sounds have been produced by it.

FIG. 176. A WELL PACKED AUDITORIUM

CHAPTER III.

THE STILL SLIDE.

Although the bulk of projection in the modern cinema theatre consists in showing moving pictures, yet there is a certain amount of still projection which gives relief to the eyes and variety to the program.

Still slides shown in the electric theatre consist of titles photographic and non-photographic, illustrated song slides, and topical slides illustrating local events.

Title Slides (Non-Photographic).

The usual hurriedly prepared title or announcement showing on the projection screen in thin, somewhat ragged lines upon a black, or reddish ground, is made thus :

A photographic lantern plate of the 'slow' or 'gaslight' variety is withdrawn from its box without any precautions against light fogging, since it is not going to be employed in its photographic capacity. A needle is stuck through a cork so that only about quarter of an inch of its point projects. With this needle held almost vertical the necessary wording is scratched upon the emulsion side of the lantern plate.

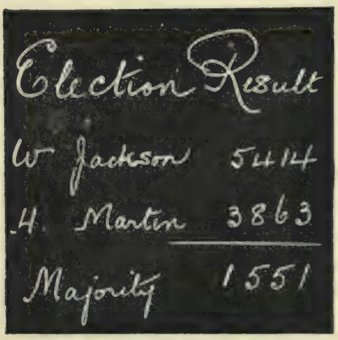


Fig. 177. A Typical "Scratched in" Announcement Slide.

The above procedure, though producing slides of a distinctly home-made appearance, has the merit of being within the reach of operators possessing neither photographic nor artistic skill. At the same time, where the producer is more or less of a draughtsman, the following way of making announcement slides will be found far preferable.

Method 2.—In this case, start with a plain piece of glass of the regulation size ($3\frac{1}{4}$ by $3\frac{1}{4}$ inches). The materials required for putting on to it the announcement consist of a good medium sized camel hair or sable brush and a bottle of 'photographic stopping out medium.' The Vanguard Company's 'Photopake' is a very good medium for such work.

Apply it by means of the brush and it will be easy thus to produce the necessary wording upon the glass in dead black opaque characters. When the announcement is painted and dry back it with a piece of tinted glass—red, green, or blue—such as is obtainable

at any glazier's, and bind the two together around the edge by means of binding strips, after the manner of an ordinary lantern slide.

Photographic Titles.

The title slide used for projection purposes is in this case a photograph from an original, which original may take the form of a title card neatly printed in black on white at the nearest printer's. If the projected title or announcement is also to show black on a white or tinted ground, then the procedure is to photograph it in the ordinary way and proceed to print a positive lantern plate off the resulting negative, also by means of photography. If, on the other hand, the title or announcement is to have white letters on a black background start from the ordinary black or white printed original just the same, but use the negative itself for projection. Often such a negative as photographed direct from a printed title card will show inordinate weakness of contrast between what should be the white and the black parts. In that case, it should be intensified by means of the copper-silver intensifier after fixing and washing.

Topical Slides of Local Events.

The making of these is by no means difficult, nor does it call for any great skill in photography. Also, the first attempts on the part of the operator to master the rudiments of the art can be made best and cheapest upon the production of topical lantern slides. If successful, these same attempts may then prove the thin end of the wedge towards mastering the much more difficult management of the motion picture camera.

The apparatus required to start snap-shotting consists, first of all, of a small quarter-plate hand camera. Such may be bought for anything from about 5s. upwards. Besides this, we shall require the following sundries: Packet of quarter plates, (ordinary brand), packet lantern plates, developing dish, printing frame, dark room light, photographic measure, jug of water for washing, one bottle (or packet) developer, one pound 'hypo' for fixing. The whole of the above will cost about another 5s. Thus, 10s. is the amount which must be speculated if we are to try our hands at topical still view work.

Taking the Negative.—Having loaded the camera with negative plates, which loading must be done only by the light of the dark room lamp, it is taken out into the open, the lens pointed at the object to be photographed, and the knob controlling the shutter pressed. Provided the light is good at the time (sunlight), and that the camera is held steady, a photographic record should be made on the foremost plate in the camera's magazine. This plate will, however, require to be developed to make the record visible. Take the camera back to the darkroom, remove the exposed plate, place it in the developing dish and flow on the developer. After a short while the invisible 'latent' image will come out. Fixing and washing complete the photographic operations.

Making the Lantern Slide.

After the negative has dried by itself (which will take about eight to twelve hours), place it in the printing frame in the dark room and put behind it one of the lantern plates out of its box. Expose the two in contact to light according to directions supplied with the lantern plates, and develop the latter in the same way as the negative was developed. When the lantern plate is dry it has a mask placed over the edges and parts which are not required to show on projection. This mask takes the form of a piece of black paper, with a hole either circular, oblong, or lozenge-shaped in it. The slide is spotted upon this mask, and finally a plain piece of glass, known as a cover glass and of the same size as the lantern plate, is bound over the emulsion side in the well-known manner by means of gummed paper strips stuck round the edge. More detailed instructions in the making of lantern slides by photography may be found in any beginner's handbook of the still picture camera. Those capable of using their own judgment and of adapting methods to their needs, will also find all they want—only given in its relation to motion picture making—in the first part of this volume.

Spotting Lantern Slides.

This matter, although very trifling from the point of view of trouble involved in carrying it out, is of absolute importance to the exhibition of all still view slides, whether announcements, title, or otherwise. The word "spotting" means in this case the actual provision of a white paper spot or patch which must be stuck inside the cover glass or on the mask before binding the slide up. This spot must be so placed as to be visible on one side of the slide only, and in such a position that when the slide is in its carrier with the white spot in the bottom left hand corner on the side away from the screen, projection will be right way round and right way up.

Where the spotting of a lantern slide is omitted, there is always even with the best operators an element of uncertainty as to the projection being correct as regards way up and way round.

Formula of the Copper Bromide (Copper-silver) Intensifying Bath.—This bath was mentioned earlier in the chapter as the one for increasing contrast in black and white titles. Its formula is here appended.

Solution 1.	Copper sulphate ...	100 grains
	Potassium bromide	100 grains.
	Hot water	2 oz.

Dissolve the chemicals separately each in half the water, mix, and allow to cool. Then bathe the negative in the mixture till it is bleached white. Wash quickly and transfer to

Solution 2.	Silver nitrate ...	45 grains.
	Distilled water ...	1 oz.

In this second solution, the original black parts of the negative should darken again and become very dense, while where the veil over the clearer parts was not pronounced, it will lift completely away.

Wash well and dry.

Illustrated Song Slides.

Most of these are supplied ready made and coloured by the various firms dealing in picture and variety show music. At the same time, there may be occasions where a local effect introduced here and there will add greatly to the point of a song. A certain song now being issued, with slides for the picture theatre has a refrain introducing the catch words 'Beautiful Devonshire.' Obviously, when singing this in another county the name of that county would have to be substituted. But if also, a slide of some local scene were introduced upon the screen from time to time, interspersed with the regular illustrated slides, the local colour would undoubtedly become far more convincing. For such local scenic lantern slides the nearest professional photographer may be found a satisfactory source of supply, or where the operator is handy at snap-shotting he can turn out the necessary for himself. In the case of utilising posed figures to heighten the effect of the song the matter becomes considerably more intricate. Not only shall we have to find suitable models for the work, but also we must evolve pleasing poses wherein to arrange them. This is by no means an easy matter, though where the best is to be made of a fair to medium model one can often gain a considerable advantage from what is known as front lighting. By this is meant not that the light is arranged to strike towards the front of the model from behind the camera, but that the light source is itself in front of the lens. In such a case the faces of those posing before the camera will be more or less in complete shadow, while in the case of female models very pretty effects of light playing through the hair may be obtained, and these often go a long way towards success in the general impression left upon the audience.

Song slides are usually coloured, this being invariably done by hand. For colouring them solutions of the aniline dyes are used, and these are applied by means of ordinary paint brushes. Where the surface of the gelatine of the finished lantern slide shows a tendency to repel the dye or to absorb it unevenly a drop or two of prepared ox gall, obtainable from the artists' colourman, will put things right.

Keep the first washes of dye well on the light side, also select good large areas for their application. Sea, sky, banks of foliage and such like should first be coloured lightly. After this, more concentrated colour is applied to the smaller objects in order of their brightness. Where very brilliant flowers, jewels, or other small and gaudily tinted things come into the view they may be touched up with transparent oil colour, obtainable from the larger dealers in artists' materials, and selected especially for the purpose in hand. Needless to say, no oil colour should be applied to the gelatine till

after it has got bone dry again following the application of any watery dye previously used for tinting.

Dissolving Views.

Song slides undoubtedly gain much from being shown as dissolving views. Dissolving view work necessitates the installation in the operating box of a special 'biunal optical lantern.' This is quite distinct from the moving picture projector. In fact, with such a biunal lantern installed in the box the usual shift-over lantern slide showing attachment of the projector is not needed.

A biunal lantern consists of two still view projection lanterns mounted one over the other with their lenses so tilted on their axes that the projection discs cast by each superpose on the lantern screen. The light sources (two in number, one for each optical system of the biunal) are so arranged that turning on illumination in one lantern simultaneously (or nearly simultaneously) turns it off from the other. In the case of limelight biunals this effect is gained by the turning of oxygen into one mixed jet and off from the other, while with electric biunals it is best to leave both the actual light sources on all the while and operate the dissolving effect through the interposition of iris diaphragms fitted on either objective, and so connected that the opening of one iris closes the other.

To dissolve one view into the next by means of the biunal lantern place the two slides in position in front of the two condensers in their respective carriers. Show the first one. Then at the moment for change turn off the light beam from the one showing, and turn on the other. Such is the operation of working the dissolving view lantern in its simplest form. As an outcome of this same system, and by means of careful centring of the projected discs of light, coupled with equally careful centring of the slides in special wooden holders, it is moreover possible to conjure into effect the many startling optical metamorphoses common in the old-fashioned still view displays of the better sort. For instance, a certain cathedral is shown on the screen. While the audience watches the windows become lighted up from within, etc. Triple lanterns consisting of a combination of the biunal with yet a third optical system have, in the past, also had their vogue, the advantage with them being the possibility of still more daring optical metamorphoses than those of the sort before mentioned.

A very good way of showing song slides in the single lantern with partial dissolving (or rather curtain) effect, is by means of what is known as the Davenport carrier. With this carrier a curtain rolling up and down covers the face of each slide at the moment when it is being changed for another, the whole idea being very like the covering of the kinematograph film picture during picture change. The only drawback—if it can be called such—to the use of the Davenport carrier is that, in common with the exhibition of dissolving views, it necessitates a separate (in this latter case, single) announcement lantern being installed, apart from the projector. As a matter of fact, however, the

push-over movement of the projector for lantern slide showing is only at best a makeshift. It is far preferable, whether forced to or not, to run announcements and song slides in a lantern of their own.

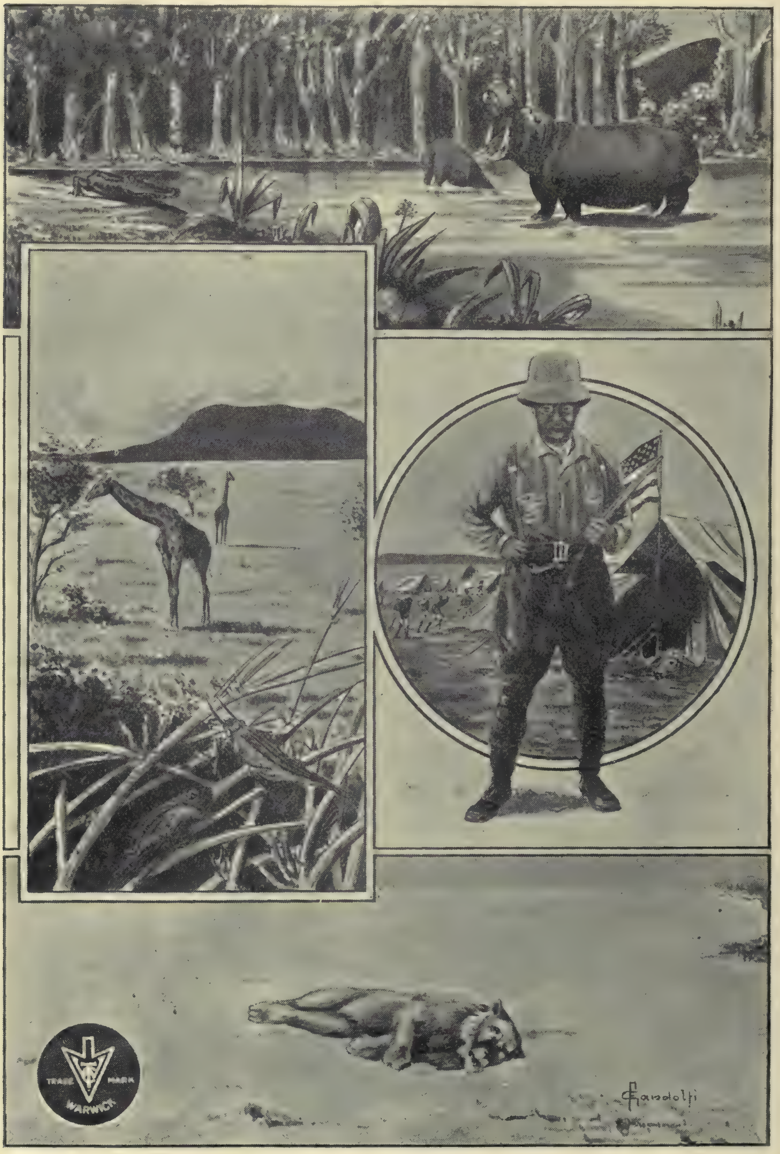


FIG. 178. SOME RESULTS OF THE WARWICK TRADING CO.'S ENTERPRISE.

CHAPTER IV.

THE KINEMATOGRAPH CAMERA ABROAD.

So great a part of kinematography now deals with the production of films of foreign scenes and customs that no text book on moving pictures could be looked upon as complete without mention being made of this branch of the art. It is to be hoped the following hints on the exposing of film abroad will be of use to at least some of our readers.

First and foremost, when touring in foreign lands with the moving picture camera, one must know just what kit is necessary for the work and just how it may be carried from place to place with the minimum amount of trouble, expense, and anxiety. Needless to say, the camera, tripod and spool boxes are always necessities, as is also an adequate stock of perforated negative film to last through the trip, or so much of it as may elapse before the opportunity arises of replenishing the supply. But with regard to the carriage of developing kit there are two courses open to the photographer. Either he may re-box his exposed film and send it home for development, or he may carry portable developing kit with him and do the work himself while on tour.

The first of the two expedients is not only by far the most simple, but will obviously be the one to commend itself in every way where possible. Where exposed film is sent home undeveloped one simply has to save the original tin and wrappings of the film stock and repack after the day's work, using for the purpose of obtaining the necessary red light a small portable dark room lamp, such as are sold by the hundred at all photographic supply shops.

Loading and unloading film stock in and out of spool boxes in hotels or other houses where there is no regular darkroom available is done at night. When it is dark draw down the window blind closely as a further precaution. If the room is then so free from stray light beams such as moonlight, the reflection from street lamps, etc., that one cannot see one's hand before one's face, the portable ruby lamp may be lit and the work of loading, unloading and repacking of films for shipment home proceeded with. Often, however, no mere drawing of a window blind in a hotel bedroom will give the necessary pitchiness to the apartment's interior. It then becomes essential to drape the bedclothes, carpet, or whatever material may be handy, over the curtain rods, or tack it up against the window apertures until a real 'dark room' has been manufactured.

Having got the exposed film safely reboxed in its tin cases, and the edge of the tins sealed round by means of the usual adhesive tape,

the repacking is completed by affixing to the top of each tin a label bearing the following data :

Title of subject taken.
Length.
Stop used.
State of Light.
Suggestions for development.
Special remarks.

The package in which tins of exposed film stock are put up for sending home should have attached to its exterior a label printed in the language of the country and plainly declaring the nature of the contents "Exposed kinematograph films (undeveloped). Sensitive to light." It is well to add the following: "To customs officers. Examine only by ruby light, or the contents of this package will be spoiled."

If such labels are duly placed on the packages, all that is possible will have been done to save the films from ruin through over-assiduity of foreign customs officials.

Many kinematographers who adopt the system of sending home exposed film stock for development take with them besides the ruby lamp a small supply of photographic developing and fixing solution and an ordinary quarter-plate developing dish. With these simple additions to the travelling kit one can develop test slips off the ends of exposed stock before sending home. Thus, one can satisfy oneself from time to time that all is well with camera, film, etc. In short, one knows pretty well from such test developments how the bulk of the film may be expected to turn out at home.

This, then, is the simple way of getting over the development difficulty where such a way is applicable. Unfortunately, there are numerous occasions which confront the kinematographer in foreign lands where the method cannot be resorted to. For instance, many of the most interesting travel films are secured under such climatic conditions as to render it impossible to retain the undeveloped film in good condition sufficiently long for despatch home. Sometimes one may contrive matters by hermetically sealing the tins in which exposed stock is returned. M. Andre Barlatier, the well-known kinematographer for Messrs. Raleigh and Roberts, also the Eclipse Company, says in this connection that it is an impossibility to return exposed and undeveloped film stock from India in good condition, unless such is absolutely hermetically sealed in tins as soon as used. Needless to add, the tins in which the unexposed film is taken out must also be closed with an airtight seal. Film kept in India in unsealed tins is generally useless in about fifteen days, says this authority.

Another operator having great experience of work in India, Mr. McKenzie, of Kineto and the Natural Colour Kinematograph Company, makes no attempt to preserve exposed film stock in its

undeveloped state. Here, then, we come to the second alternative in actual operation. Mr. McKenzie on his last Indian tour took with him a self-contained developing plant, including hundred foot folding pin frames for development, developing, washing, and fixing tanks, made of waterproofed wood and nested for convenience in carrying, and last but not least, a folding drying drum. The latter instrument was, by all accounts, particularly cleverly constructed. The light wooden lathes of which it was made took apart and folded up in a bundle for purposes of transit. Of course, with complete portable developing kit one is confronted with the necessity of carrying a correspondingly weighty and bulky amount of chemicals. At the same time, the writer is informed the system of nesting the chemical troughs and providing a collapsible drying drum, as above referred to, allowed of the whole developing kit being loaded on to the shoulders of a couple of Indian coolies and by them carried in comparative comfort.

Where film is thus developed abroad, especially where the water supply is not good, it will often be found impracticable to give it more than a very superficial washing after fixation. In fact, in very hot climates thorough washing would be impossible without recourse to ice cooling of the washing water or the intermediary use of a hardening bath. Otherwise the gelatine would melt and leave its celluloid base entirely. Practically therefore, the way generally adopted is to give the fixed film a good ten minutes' rinse in three or four troughs full of clean cooled water, then to dry it at once on the wheel and despatch home for further thorough washing prior to printing.

Developing, washing and fixing baths should be iced down to 70 F. or thereabout before the film is immersed in them. Otherwise, the subjects run a big risk of being spoiled.

Where, in the tropics, it is decided to harden film prior to fixation, the formalin bath, as given in Part I., should be used. It must not, however, be employed till after development and subsequent washing of the film, or fog will result. A better way would be to employ a fixing bath containing alum or chrome alum and plunge the developed film straight into it. Such an alum fixing bath would harden the film at the same time, and so tend to prevent solution of the gelatine due to subsequent too warm a temperature of the washing water.

M. Barlatier has found that working in Southern India, where it is not uncommon for the temperature to go up as high as 120 F. in the shade, a reaction will sometimes set in between the emulsion and base of the dry unexposed film stock. This causes the emulsion to become brittle and shale off in flakes from the celluloid as it passes through the gate of the kinematograph camera. For such a state of things as this there would seem to be no possible remedy.

Mr. George Albert Smith, the inventor of Kinemacolor, informs the writer of a very ingenious dodge of his for preserving exposed

and unexposed Kinemacolor stock in good condition during its voyage on shipboard to and from a foreign country. The same dodge would undoubtedly be applicable to any other film stock. It is simply to tip the head steward on board the ship to store the tins containing the stock in the ship's ice safe, or refrigerating room if there is one. Under such circumstances film keeps in prime condition. On account of its extreme simplicity the tip is well worth remembering by those going abroad on kinematographing expeditions.

FIG. 179. ENCHANTING THE NIGGERS.

CHAPTER V.

KINEMATOGRAPHY IN COLOURS.

The coloured moving picture, as seen on the screen, may be produced in two ways. It may be the result of pigments or dyes applied to the celluloid film, or the natural tints as seen on projection may be due to some process of optical synthesis having photography as its base. The former class of coloured subject is exampled in the Pathe ' Coloured Cinematography,' also in the Gaumont coloured films. In both of these as in the case of all other commercial film subjects, where the colour is apparent on the celluloid positive upon hand inspection, the system employed is one of hand or machine tinting either by brush or ' stencil.' In any case, there is no mechanical guarantee that the colours as projected are either identical with or even near to those of the original. They may and probably will be pleasing.

In the only existing commercial system of photographic colour kinematography—Kinemacolor—hand inspection of the positive film would show no trace of colour upon it whatsoever. Neither do the film pictures used in any other existing system of literal colour kinematography (in the photographic sense of the term) show colour in themselves.

One of these days, it is possible the world may see colour kinematography on much the same lines as those by which the celebrated Autochrome direct colour photographic transparencies are now produced, but that time is not yet.

The Principle of Colour Recording by Photography.

Towards the beginning of the nineteenth century two investigators, Young and Helmholtz, propounded a theory of colour vision. This theory, whether right or wrong, is, at any rate, sufficiently near the mark to serve as the fundamental proposition in what has come to be named ' three colour ' photography. According to it, all light sensations are received through the medium of three distinct colour-sensitive elements in the retina of the eye. These are the red, the green and the blue violet elements. Intermediate colours send their record to the brain by affecting in various degrees any two or as the case may be—all three elements of the eye. Thus, when we see white light, it means that all three colour elements in the eye are being equally excited. When we see yellow, the red and green elements only are excited, with blue-green, the green and blue violet elements alone are strongly excited, and so on. Elaborating the theory on these lines, and presupposing the existence in the retina of the three (and three only) distinct sets of primary colour sensation perceiving elements, it can be made to fit in with the perception of all the numerous half-way tints and complex tones perceived in the world around us.

In colour photography as usually practised, records in monochrome are taken, one through a red glass (or filter), one through a green filter, and one through a blue violet filter. By suitable combination of these colour records, the original colours of nature may be reproduced within the limits of practical error.

Thus, suppose three negatives taken from a coloured original, one through red, one through green, and one through blue glass, it is obvious that the opaque silver deposit on these will represent partially the light and shade of the object or objects photographed, but it follows, too, that each negative will also hold in the varying density of its silver deposit a record of the amount of colour possessed by the original objects corresponding with the transmission of the particular light filter through which it was taken. Suppose positive transparencies to be made from the three negatives, and that these positive transparencies are backed by glasses of the colour through which their respective negatives were taken. Further, suppose these three backed transparencies to be projected and the images as thrown to be superimposed on the projection screen. Then if the practical side of the thing has been properly carried out, we should have a true projected photograph in natural colours.

To demonstrate the reason simply on paper is, nevertheless, none too easy. Still, in order to start the mind on the why and wherefore of additive three colour projection, let us suppose the original photographed to be a red flower with green leaves. For the sake of simplicity, we will for the moment ignore the third blue-violet record. Arguing as simply as possible, we see that the red record negative will show the flower as a heavy deposit, while the leaves, being green, will leave only clear gelatine upon the glass of the photographic slide. With the green negative matters will be just the other way about. In the positives made from these negatives, the relation of the deposits to original colour will, of course, be reversed. Accordingly, we find the red record transparency showing the flower as clear glass and the leaves as opaque deposit, while in the green record positive, the flower is opaque and the leaves transparent. Back each record with a glass similar in colour to the one with which its negative was taken and project the two images in superposition on the screen. We get a red flower projected through one lantern and green leaves projected through the other. In the case where shades of blue come into the scheme, the third colour, or blue-violet record, would get its look in in precisely similar manner.

It must be noted that on this system—since white is for the purpose of the Young-Helmholtz theory compounded of the three primary colours red, green, and blue-violet—the superposition of these three colours in correct quantities should give white on the lantern screen. This is found by experiment to be the case, such resulting artificial white being called 'synthetic' white, to distinguish it from the real white of the solar spectrum. Superposed red and green are similarly found to give synthetic yellow, while superposed green and blue-violet

give synthetic blue-green. Superposed blue-violet and primary red give synthetic pink or rose. Rose, yellow, and blue-green are accordingly known in colour work as 'secondary' colours, each being due to combination of two of the primaries. So much for the Young-Helmholtz theory of colour photography. Now to see how it has been applied to the moving picture.

The original attempt to adapt three-colour to kinematography seems to have been made by the investigators Lee and Turner, and is embodied in their patent of 1899.

In the Lee-Turner process, the colour records were made by means of a camera fitted with a single lens and revolving colour filter holder containing three colour filters, red, green and blue. Projection was by means of three lenses, before which were colour filters of somewhat complicated design. The great drawback to this process was that it came into existence too early, before the necessary colour sensitising operations for kinematograph film had been carried to a point to make the film of workable sensitiveness. The Lee-Turner patent was purchased by Mr. Charles Urban, and is still held by him.

The next important chapter in colour kinematography would seem to be the exhibition in Paris in 1904 of a two-colour system of motion projection invented by Dr. Jumeaux and another. In this system prisms were used in taking the negatives, such prisms throwing a double image upon the kinematograph film. On projection of the resulting transparencies, the same prismatic system was employed to blend the two colour sensations. Though no two-colour process can ever give natural colour results (any more than any photographic lens can ever realise true depth of focus, both suppositions being in the realm of sheer theoretical impossibility) the prismatic two-colour experiments served to reveal to investigators several important things. One of these was that a two-colour system while not being quite true to nature, might yield very pleasing results. Another point made plain was that no system involving the cutting down of the area of the already too small kinematograph picture could have a chance of commercial survival on account of the difficulty of transmitting through the lessened aperture the comparatively huge amount of light necessary for colour projection. Also it was seen that prismatic splitting up and reblending of images tended to want of sharpness of the projected result. So the practical investigation of what might and what might not well be attempted in colour projection is found by now to have proceeded somewhat.

Then came word of Kinemacolor. Here we have a system embracing the line of least resistance as mapped out by prior work in colour kinematography. In Kinemacolor, panchromatic kinematograph film (that is to say, film rendered sensitive to all colours) is exposed in a special kinematograph camera. This instrument is practically similar to the ordinary black and white motion picture camera, except that between the rotary light shutter and the gate

is a second rotating filter frame carrying on its opposite halves the two colour filters employed for making the two-colour records.

Kinemacolor employs two color filters only, one of them being usually orange red, the other a rather bluish green tint, while the *British Journal of Photography* for August last describes yet an alternative type of colour filter for Kinemacolor and kindred two-colour process, whether of kinematography or of still view photography, worked out by the author, and by him considered to have certain advantages in practice. However taken, Kinemacolor results are not scientifically such as to be termed absolutely true to nature in hue. None the less, the variation from the theoretical perfection of Kinemacolor projected pictures is often surprisingly small. The process is, moreover, deserving of all honour, as the first truly successful and commercial adaptation of colour photography in any form to motion picture work. The Kinemacolor patent is the joint invention of Mr. George Albert Smith and Mr. Charles Urban, the noted kinematographer and head of the Natural Color Kinematograph Company.

The mechanism of the Kinemacolor camera actuates the 'colour filter frame' so that every alternate negative taken will be a red-orange and a blue-green record. Needless to say, special care is necessary in developing panchromatic film, but once developed and fixed, the film is printed from as if it were ordinary black and white negative.

In projecting the print, a projector is used fitted with a rotating colour filter frame carrying red-orange and blue-green filters, as with the taking camera. Thus every alternate positive will be shown respectively by red-orange and blue-green light. These alternate red-orange and blue-green pictures blend in the retina through the well-known and already explained kinematographic principle of persistence of vision, producing on the screen the effect of natural colour.

Besides Kinemacolor, which claims rather a large place here on account of its being at the moment of writing the only commercial colour kinematographic process, several other systems of colour kinematography have been more or less worked out

Mr. H. W. H. Palmer has taken out several patents in which he uses the three colours. His chief departure from other investigators is that he leans to the use of a circular glass plate as his base, instead of utilising kinematograph film for the colour record images. Undoubtedly, glass as a base has much to be said for it in place of celluloid, especially for experimental machines.

Mr. Friese Greene also has his system of colour kinematography, which has even been exhibited in an English picture hall for the delectation of the public. It is reported, however, that the exhibition was not such as to show the process to have been brought to the commercial point.

The author has recently had granted to him a patent (1642 of 1911) for an improved camera for taking colour record negatives either for two or three colour systems of projection. The novelty

about his system is that it employs three lenses in conjunction with stationary colour filters and a multiple picture shift. Such an arrangement being quite novel in the history of colour kinematography naturally possesses advantages also novel, and which will be appreciated better on perusal of the actual patent specification. The lenses of the 'Bennett' system camera being placed one above the other, it is still possible to obtain all colour records on one and the same band of film, while minor parallax errors are also provided against.

Safe Lights.

While ruby and yellow glass may prove fairly suitable in combination as a filter for the light utilised in dark room illumination during the loading and development of ordinary non-colour-sensitive kinematograph film, such will be useless when handling the panchromatic film necessary in colour work. Further, even when dealing with non-colour-sensitive stock, the amount of light which may be passed by commercial ruby glass without injury to the film is very small in comparison with that which might safely be allowed to issue through a proper 'safe light.' A suitable safe light is a necessity when handling undeveloped colour stock, and a great luxury at other times. Directions are therefore appended for the making of safe lights such as will be found of use in the dark room lamp or lamps when handling any sort of film from slow positive to fastest colour-sensitive negative stock. Needless to say, the same coloured safe lights will not do for all purposes. A series of three graduated ones will therefore be given, with directions such as will enable the experimental photographer to make each for himself.

Canary Yellow Safe Light.

This safe light allows of a brilliant yellow illumination, which is yet quite safe for use when handling positive stock. The light is at least four times as bright as that passed by commercial yellow glass, which latter, however, would not be safe for use at all. The safe light is made thus:

Fix out two undeveloped photographic plates of a size to fit the dark room lantern to be glazed. Wash the fixed plates, and they will now have left on them only a coating of clear gelatine. Proceed to dye one plate in a strong (5 per cent.) solution of filter yellow K, Hoechst. Dye the other in strong Metanile yellow, Grubler. Rinse both plates after dyeing and stand them up on end to dry. When dry, bind them together face to face, having placed a sheet of tracing paper between the two to diffuse the light from the light source. Engineer's tape is suitable for binding the glasses together, and is applied round the edges after the manner of lantern slide binding strips.

Safe Light for Handling Ordinary Negative Film.

Treat one plate with filter yellow solution as above, but dye the second a deep rose in Rose Bengal solution. Bind the two up when dry, having interposed between their faces a sheet of tracing paper soaked in strong Metanile yellow solution so as to make it almost orange in colour, and subsequently dried. This will give a deep ruby coloured filter, passing considerably more light than ordinary ruby glass, and at the same time far more safe for use in dark room illumination.

Safe Light for Use with Colour Sensitive Film.

Dye one of the fixed out plates deep violet in Methyl Violet solution. Dye the second plate orange yellow in a solution of strong mixed Filter Yellow and Metanile Yellow. The translucent paper bound between the two plates must be stained green in Naphthol Green dye solution. This filter when made up will be very dark, and will pass only a small quantity of light in the pure green to bluish-green part of the spectrum (technically known as little b). Though the light is very faint, it will be found to penetrate the darkness comparatively well, so that after a little while, the eye will be able to distinguish objects in the dark room more or less. Thus, this faint green glow becomes a considerable help in the admittedly difficult operations of winding and developing colour sensitive film. A brighter safe light can be made by substituting Filter Blue Green, Hoechst, for the Methyl violet wherewith to dye the one plate, but in this case the filter will have to be used with much caution, or fogging of the panchromatic film will result.

Note.—Even the deepest *red* filters are useless when handling panchromatic film.

Screen Ruled Colour Film for Kinematography.

Mention has already been made of the possibility of a future type of colour kinematography utilising some such system as that now employed in the celebrated Autochrome plate for direct still colour photography. This, which is known as the 'screen plate' system, depends upon covering the base upon which the photographic emulsion is afterwards coated with a patchwork of minute areas dyed in the three primary colours. Exposure is made through the back of the film or plate, and the resulting patchwork colour record 'reversed' in a chemical reversing bath instead of being fixed in the ordinary way. The Lumiere autochrome process utilises dyed starch grains for the purpose, but other kindred screen plate systems rule minute microscopical or crossed lines of clear primary colour on the glass or celluloid emulsion base.

The present difficulties in the way of adapting screen plate systems to the motion picture record are several in number. For one thing, there is the trouble of obtaining sufficiently rapid exposures even in the brightest light. Then the amount of light absorbed by the coloured film base on projection is very great. Also, where magnification is high, a spotty effect may be produced on the projection screen.

Still for all its present drawbacks, both in manufacture troubles, expense, and difficulty of working, there is at least a sporting chance for the future of the screen-ruled motion picture film.

FIG. 180. EXTERIOR AND INTERIOR OF A MODERN PROVINCIAL MOTION PICTURE THEATRE.

CHAPTER IV.

SCIENTIFIC AND TECHNICAL KINEMATOGRAPHY.

Scientific kinematography is a branch of the motion picture art the details of which must be worked out by each investigator in conformity with his particular line of research. At the same time, there are certain broad hints which may be given, and which may help towards making a start in a particularly fascinating and almost unexplored branch of kinematography.

Micro-Kinematography.

This is a combination of the microscope with the motion picture camera, just in the same way as the microscope and still picture camera have for many years been combined for micro-photography. Broadly speaking, the same fundamental considerations as to technique apply in both cases. Such main considerations may be summarised as the obtaining of 'critical' illumination, absolute rigidity, and sharp focus with what is known in microscopy as good 'resolution,' or differentiation of minor microscopic details by the objective lens of the optical system. In motion picture micrography we shall in addition to the above require that the light be sufficiently powerful to permit of such turning rate as may be necessary for any given piece of work.

Turning rate, let it be noted, does not in scientific kinematography mean of necessity the regular sixteen pictures a second of ordinary studio and field work. Quite recently, a form of high speed micro-kinematograph camera has been invented in France with which as many as two to three hundred pictures a second are obtained. This particular camera is not fitted with intermittent movement. It relies on the light from a stream of sparks given off by a static electrical machine as the source of illumination of the successive pictures. The duration of each spark being almost infinitesimal it has been found that quite clear-cut images may, by such illumination, be obtained upon the fast rotating kinematograph film as it whirls round upon the rim of a drum in the plane of focus of the objective lens.

As an example of a contrary class of scientific motion picture may be cited the 'Bud to Blossom' series in connection with 'Kinemacolor' two-colour kinematography. Apart from the question of colour, the interest of the films here depends upon great speeding down of the camera mechanism during taking of the subjects. The films so produced depict the opening of various flowers before one's eyes.

To obtain such a speeded-down series all that is necessary is a system of gear wheels driven by a small electric or other motor, whereby the motion picture camera escapement may be driven at a constant

rate, such rate to be far below the normal. Thus, suppose it is found by experiment that a certain flower bud placed in water takes from two to three days to open, and such opening of the bud is to be recorded so as to show in the space of one minute, we may arrive at the exact speeding-down required as follows :—

Three days equals 72 hours, or 4,320 minutes. One minute's exhibition of kinematograph film at normal rate equals 60 feet, or 960 pictures. Therefore, our 960 pictures must be divided into taking intervals spread equally over 4,320 minutes. That is to say, the interval between the exposure of each successive picture in the speeded-down camera is to be 4½ minutes.

We accordingly arrange that our speeding-down gear shall operate the picture movement once every 4½ minutes for three days. What portion of this time shall actually be occupied in exposure may be determined within certain limits by the adjustment of the camera shutter opening. Suppose each exposure is to give one minute of actual light impression on the film, then it is obvious our light source need be much less than that obtainable from daylight. Also, since daylight will wax and wane three times in three days it must be equally obvious such in any case would not be available by us. Accordingly, suitable artificial illumination has to be provided in the speeding-down laboratory.

For such comparatively large sized objects as flower buds where no microscope attachment is needed a couple of small and suitably shaded metallic filament electric lamps, placed one on either side of the object to be illuminated, would be in most cases quite sufficient. With microscope attachments, however, the light source will have to be much stronger. Also, a great deal depends on how the original light beam is collected and parallelised prior to striking the microscope's optical system. We append a sketch showing the microscope with its illumination as arranged for micro-kinematography.

A (Fig. 181) is the light source, shown here as an electric arc lamp such being the most powerful, and generally speaking, most suitable light for the work. From the lamp A the light beam passes outward to the lens B known as a stand condenser. Stand condensers for micrography are (unlike those used in moving picture projection) highly corrected instruments. The stand condenser should throw a clear achromatic or colourless light beam through the cell X, which contains glycerine or water, with, perhaps, the addition of some colouring matter, according to the work in hand. The functions of the cell X are to cut off as much as possible of the heat rays from the microscope stage. Also, where colouring matter is added, the resolution of the microscope objective may be improved thereby. Other reasons for the use of a colour trough in special cases may deal with the production of contrast in the film image, and similar points not necessary to go into at length here.

Leaving the glycerine cell, the light pencil falls upon the substage condenser C, in a very brilliant and concentrated patch, which, in its

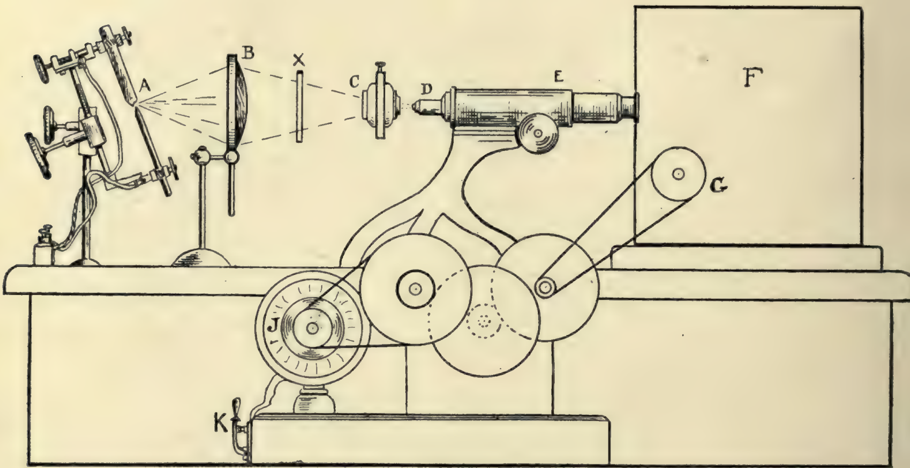


FIG. 181.

turn becomes further concentrated by this second condenser, emerging upon the object on the microscope stage as almost a pin point. It is in this way that the object to be photographed is illuminated. Afterwards, the light beam passes on through the objective lens D, and the eye piece E of the microscope, till the image is brought to a focus upon the film in the gate of the motion picture camera attachment shown at F.

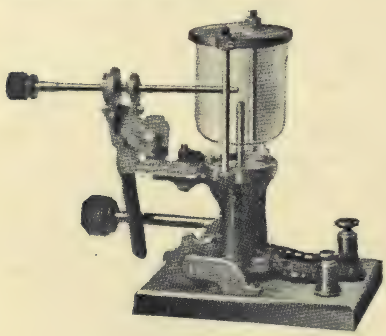


FIG. 182.
"WESTMINSTER" RIGHT ANGLE SEMI-AUTOMATIC ENCLOSED ARC LAMP.

The camera lens will, of course, have been removed before the adaptation of the instrument to its use in micro-kinematography. G shows the driving pulley actuating the picture changing movement and connecting by means of a belt through the gearing down wheels H with the electric motor J, the latter being controlled by a switch or rheostat K.

Fig. 181 shows the micro-kinematographic system arranged in horizontal position, in which case the microscope stage will be vertical. When photographing such subjects as animalculae moving in liquid and suchlike, it will be necessary to tip up the whole arrangement on end so as to make the stage of the microscope horizontal. When starting first experiments in this line of research, it will be advisable to use only microscope objective lenses of low power, say from two

inches to half an inch focus. With very low magnifications the eye piece E may well be dispensed with altogether. For higher magnifications, one of the 'compensating' type eye pieces, or better still, a 'projection eye piece' will be used.

Where the electric arc is not available for experimentation in micro-kinematography limelight may be substituted. Also, water motors or hot-air motors can be made to take the place of electric ones for such light work as the turning of the geared-down escapement where such is used. In high magnification work, where great resolution is required, and consequently wide apertures of objective and substage condenser become a necessity, it may be found necessary to have the optical system of the microscope of the apochromatic variety.

Tele-Kinematography.

There would seem to be a considerable field for the application of the motion picture camera to the telescope, especially to the astronomical telescope. At the present moment, photographic charts of the heavenly bodies are made through the telescope with ordinary still camera attachment, working on just such a general system as the one in common use for photo-micrography of still objects, except that in tele-photography the distant objects provide their own natural illumination. Now, as made by tele-photography star maps either show one fixed position only of the heavenly bodies, or else they give the general direction of these in the form of lines due to the movement of the earth during exposure.

The motion picture combined with the astronomical telescope affords a ready means, not only of recording the direction of apparent travel of the heavenly bodies, but actually of recording the motion itself. For this purpose undoubtedly, some system of gearing down the rate of taking to compensate for want of light in the bodies themselves, as also for reasons of economy of film length exposed, would, however, be necessary.

In terrestrial tele-knematography also, there is a wide field and a very interesting one for the exploitation of the motion picture man with ideas of his own. Who, for instance, has not from the seashore looked through a high power glass at shipping passing over the horizon ? Such effects of distant ships passing, to say nothing of many another odd and interesting subject, would most certainly be in range of the owner of a good terrestrial tele-kinematographic outfit. These outfits are not as yet on the market in their completed state. Perhaps this is all the better for those of us who have the originality necessary to their discreet use. Such will find no great difficulty in rigging up the parts to make the completed machine for themselves.

CHAPTER VII.

SELF-PRESERVATION IN THE TRADE.

A WORD OF WARNING.

Those who have traced the devious paths in which the kinematograph trade has trod during the past ten years must have stood aghast at the snares and pitfalls which have ever beset the honest, straightforward dealer who desired to become acquainted with a new profession. It is, therefore, but right that in such a Handbook as the present, space should be devoted to making known certain dangers to be avoided by those who seek to enter the profession.

The kinematograph trade is somewhat of a mushroom growth, and consequently during its brief existence has had many drawbacks caused by want of organisation and cohesion among its members. This has been particularly noticeable in our own country, and if one looks back to the records of 1905 it will be found the fact was already being recognised, for this year saw the first suggestion of amalgamation among kinematographers, with the object of correcting the want of solidity in the business. This took the form of a Lantern Operators' Guild, whose objects were :—(1) To see that the interests of operators were secured with regard to salary, hours and health ; (2) To determine the status of operators by a qualifying examination, and thus raise the status of this branch of the profession ; (3) To give the various branches of the trade a means of exchanging ideas and establishing a centre where trade disputes could be adjusted. But in this year the question of the operator was not the only one needing consideration, for the grievance of duplicating film subjects was much discussed, and the advocacy of registering and copyrighting films gave the manufacturers a chance of getting together to safeguard their interests. In France, which was the centre of the industry at that date, the question of co-operation was also in evidence, and a "General Cinematographical Association" was formed (1) to bind the trade closer together, (2) to hold competitions and a congress for the International Exposition of Cinematography, and (3) to form a school to grant diplomas to practical cinematographers.

About this date, Mr. R. W. Paul, who worked so hard in the initial stages of the business, threw energy into an association to preserve the rights of manufacturers, and from this was formed the Kinematograph Manufacturers' Association.

Later, we have had a Defence League to protect the showmen's interests, and a Renters' Association to bind in closer harmony the members of this important branch of the industry. But even were these organisations in working order, there are many phases of wrong

doing which the unwary are likely to be the victims of unless put upon their guard. Sharks abound in all directions, and the uninitiated will find slippery places where least they are to be expected.

Grievances of The Manufacturer.

We will first deal with the manufacturer, as the most important unit. He has suffered in many ways. Bogus companies with flashy stationery, insinuating, well-dressed and plausible representatives and sumptuous offices have ordered films lavishly, have paid splendidly at first, and have obtained unlimited credit, only finally to let the manufacturer in for a big sum. The moral is that greater care should be taken to obtain regular and prompt payment, instead of allowing the accounts to drag on.

Then, again, manufacturers have sent films on approval, and in some cases allowed over a week to elapse before their return, to find that the subjects are sent back badly scartched and worn, with a letter stating that the applicant finds them unsuitable for his requirements. Here, again, there is a remedy, and that is to forward an invoice with the goods, which states in clear terms that unless returned within a certain number of *hours* (not days) the films will be treated as having been purchased.

In a great measure, our laws are favorable to the wrong-doer, and in no case is this so evident as in that of the duplication of subjects. What is easier to a man with a knowledge of the business and the necessary apparatus than to get hold of a subject which may have cost hundreds of pounds originally, to produce and whip off duplicated copies for sale in other countries ? But individuals who have been guilty of this bare-faced robbery have over-reached themselves. They have obtained "on approval copies," duplicated them, and sold these "dupes" before the makers' release dates ; they have not been content with selling in foreign lands, but have pushed them into certain renting concerns as second-hand goods. Luckily this has been discovered, and the recent agreement between the makers and renters will put a stop to such nefarious practice.

There are firms and individuals who sell "sole rights" to photograph topicals, and who take no precautions to keep out unauthorised photographers, or to safeguard the interests of those whose money they have accepted.

The long credit demanded and taken by the renter is disastrous to the manufacturer with small capital. Some of the larger firms have taken advantage of this fact, and they have ultimately suffered from bad debts. The system of giving long credit should at once be discontinued.

Another disadvantage the manufacturer has is in having to sell all films at 4d. per foot irrespective of the cost of production and the pretensions of the subject. It seems ridiculous that a subject which has cost a thousand pounds to produce should be sold at the same

price as a scenic—for which there was necessarily no expensive preparation.

There are many other grievances from which the makers suffer, but want of space will not allow us to deal further with the subject.

Gulling the Hiring Concern.

The chief troubles experienced by those who hire films to exhibitors are those of incurring bad debts, and of having reels badly treated. With regard to the former, much of the loss is richly deserved, owing its existence to careless and lackadaisical methods of account keeping on the part of many renting houses. But not only are they in fault in bookkeeping, but price cutting and long credit are also too often used to snatch business from competitors, while, needless to say, many clients are found only too ready to take full advantage and finally to make this fatal system recoil on the heads of those who adopt it.

Bad treatment of the films is only too frequently evident to those who have occasion to see films returned after a week's hire. In all cases, it is up to the renter to loan his goods under a definite agreement, and to see that the terms of it are enforced.

The renter certainly has a grievance against many of the manufacturers and selling agents, for in many cases he is invited to see a film run through only to find on arrival at the specified time that preparations are not complete, the operator is at lunch, the film is out elsewhere on approval, or else he is kept waiting for others to turn up. Even the renter's time is money, although the manufacturers class him with the small fry, and make him wait their pleasure.

But this question of the value of time is also ignored by many a renter who breaks faith with the exhibitor by not despatching his reels to the promised time and throwing the blame on the carrier. A little more consideration is needed by both parties.

Here is a case which recently came to our notice. A certain so called but unregistered company obtained its films from a renter, and for some time all went well. But presently the company sold its picture theatre for a mere song, and still week by week the films were sent and used. After eight weeks of this state of things, the first purchaser again sold the show to another man, without telling him of the two months' arrears of film rental by now accumulated. The renters all along thought they were treating with the original owners till they suddenly learned the truth, and at the same time found they had no redress, as they could not find the individual who owned the show for the two months between the original company and the last man, while from the latter they could only recover the amount for the films he had actually used.

The loss sustained in damage to film by the carelessness of the exhibitor's employees is well known. Pieces cut out and bad joins, perforations ripped through, scratching through dirty gates, the bending or folding of the film, and many other results of rough usage can only

be realised by those who go through the reels when returned from the shows. Then there is the difficulty of attaching blame for the damaged films in the proper quarter, more especially where the transfer system is in vogue. Some method is badly needed to stop this disastrous ill-use of other people's goods.

Owing to over-production, the life even of good films is a very short one, so that taking all these considerations together, the renter does not have the rosiest time in making things pan out profitably. But notwithstanding all these troubles there is now going on a reckless reduction in the charge for hire service, and each renter seems anxious to get his competitors' customers, whether the rental may be profitable or not.

How the Exhibitor Suffers.

The renter may find some small satisfaction in knowing that the showman also has his troubles, and we will now deal with a few which have come to our notice.

First, there are the unfair tactics of competitors, who issue misleading advertisements and stoop to every device to attract clients from the opposition show. Perhaps the following will better prove what we mean. When Barker's "Henry VIII." film was being boomed a certain theatre paid a big price for the rights. Next day a hall four doors from it had in tremendous letters across the front, "Henry VIII. now showing." This proved to be an old film of the Eclipse Company, and, of course, those who expected to see Sir Beerbohm Tree's Company were disappointed, and the enterprising "sole right" man suffered by the underhand business.

Many an exhibitor objects to the system of giving exclusive rights, as being adopted to squeeze his purse still further.

Then, too, the new agreement between the manufacturer and renter is causing the showman to shout. It is suggested that it gives to the renters who are on the joint committee (if they are showmen as well as renters) an unfair advantage over other showmen in towns where they themselves possess theatres, by preventing the outside showman from buying films, and compelling him to hire instead at the renters' own figure.

Obtaining Goods and Cash by Fraud.

Too frequently has our attention been called to the loss of films and apparatus which have been forwarded in response to an apparently satisfactory "want" advertisement. The advertiser will have given what reads as a genuine enough address for the goods to be sent to.

Take one case. An advertisement appears something after the style of the following :—"To be sold after Tuesday to first person sending 20s., only used two nights (here followed the title of a subject much in request, and the value of which was quite £5). Send P.O.—Jackson, Theatre Royal, Margate." Many postal orders were sent

by persons anxious to secure so great a bargain, and in due time Mr. Jackson—or whatever his name was—called at the Theatre Royal for letters, informing the door-keeper such had been "intended for the Electric Theatre, Margate." He then scooted with the contents. The same sort of game is also played the other way round, and certain second-class films, etc., are advertised for, and exceptional cash value is offered on receipt of them. The big price tempts the owner to send along his films or apparatus, but his frequent applications for cash are returned "Not known." In both cases the lesson is taught that it is unwise to part with goods or cash to an advertiser at a distance unles his *bona fides* are known to be beyond reproach.

Here's another case :—A kinematograph operator was charged on warrant with unlawfully pawning on two dates 2,000 feet of film, and a lamp, value £23 10s., the property of a picture hall proprietor. The prosecutor stated that he advertised kinematograph supplies and the prisoner had dealings with him, receiving a number of films and a projector. Witness identified two spools of films and the lamp produced at a pawnbroker's! The prisoner's solicitor explained that his client was formerly employed as a manager of a picture theatre which was being wound up. £10 was due to him for wages, and he pawned the films, thinking he would be able to redeem them when he got his wages.

The above instances are of a painful character, but we can cite another which is even more outrageously dishonest. A well-dressed individual asked to be allowed entry to a certain hall, with the idea of renting it for a picture show. The caretaker was instructed to allow him access at all times, so that he might plan out his arrangements. Meanwhile, the applicant for the hall advertised for a manager, door-keeper, cash taker and operator. They were to apply personally on certain days and hours, and he plausibly held out possibilities that each applicant was just the man he wanted, took their addresses, and the day following their visit, each received a letter saying that he had decided to employ them, but each must deposit a certain sum (fixed according to what he thought they were worth) as security. Five of them (unbeknown to each other), glad to get so promising a job with such an excellent salary, scraped together the sums named, and after other correspondence, called at the hall, signed and took away a copy of agreement, and parted with their cash. Only after the bird had flown from his address did they learn from the caretaker that the "gent" had not really taken the hall but was considering the advisability of so doing, and although the matter was left with the police, nothing further was heard of the individual.

Then, again, there is the advertiser for "an operator with own machine and films," to give a week's show in a remote town or village. A man is out of engagement, borrows apparatus and films, pays his railway fare and goes on spec., to find at the end of his run a man of straw, unable either to continue the show, or pay his expenses.

"Dusting Down" the Investor.

How many of the directors and promotors of the hundreds of motion picture companies registered during the past three years have failed to carry out the schemes or give the results so lavishly promised in their prospectuses? How many of these schemes have been of the wild cat order, floated solely for the purpose of obtaining from the public promoters' plunder? For enticing reading, the prospectuses are enough to draw blood from a stone, and their far-reaching results have done much to frighten the investing public from further supporting the industry. It is to be hoped that the process of time has done much to weed out this element of danger which, till recently, beset the industry, but even yet new companies are sprung on the public by men outside the legitimate business and channels have to be found for the watered stock.

Companies have been formed with glowing prospects, but bad management kills the profits, and finally a friend of the directors' manages to buy for a mere trifle what has originally cost thousands.

The shareholder is trotted round the theatre, he sees the crowd guided up to the pay-box, and is told that every sixpence paid represents threepence profit to be used in paying dividends. The air of prosperity and the wiles of the managing director have such an effect on him that he not only buys more shares himself, but persuades his friends to do the same. Meanwhile, those in the know are busy unloading their own stock, and perhaps to make matters more favorable, a dividend is declared, which naturally gives further credence to the game. But there comes the evil day. Debentures are issued, reconstruction follows, and its goodbye to much hard-earned wealth as far as the shareholders are concerned.

Much more in similar strain could be written in connection with kinematograph financial matters, but like the other features of this chapter, we have had to curtail our remarks on the subject, as being somewhat subsidiary to the real purpose of the Handbook.

Fig. 183. A Travelling Outdoor Kinematograph Advertising Car.

CHAPTER VIII.

THE MANAGEMENT OF A PICTURE THEATRE.

Although somewhat outside the province of a Handbook on Kinematography, it is necessary, as this book will be used and referred to by every section of the trade, and by those desiring to enter it, that a brief chapter should be devoted to this important part of the profession.

The keen competition among the numerous halls in every part of the country makes it incumbent for the management to be entrusted to a man who possesses not only a thorough knowledge of the technical side of picture theatre management, but one who can realise and tactfully judge the desires and requirements of the inhabitants of his neighbourhood. He must be a capable organiser, a strict disciplinarian, able and willing to make himself popular with every section of his patrons, and above all, must judiciously economise so that the proprietor of the show, or its shareholders, can reap return for their invested capital.

It is the intention of the writer of this chapter, therefore, to deal particularly with the qualities necessary to the successful showman, and the way for him to go about his most important duties. The successful picture theatre manager will be *showman* in many senses, not only for showing the advantages of his picture programs, but in emphasising the comfort, cleanliness and beauty of his hall. He will further be *showman* of his own personality and ability ; *showman* in catering for the continual education and amusement of regular and chance patrons ; and *showman* in judicious advertising and skill in inducing people to visit the establishment under his charge.

And now for the particular functions of which he should have complete control.

The Building.

We take it he comes on the scene when the actual hall is erected and furnished suitably for the class of public who inhabit that particular district.

The opening, with the usual "send off," has to be arranged. It is wise to obtain the assistance of a popular individual—the mayor or local member of parliament—to perform the opening ceremony, assisted by subordinate magnates and big-wigs. This not only gives the local papers a chance of making much of the event in their columns, but binds the hall up with other social affairs, and proves one of the best advertising wheezes that can be adopted. It is up to the manager to "pull the strings" and induce the right man to take on the job. He seldom

pleads in vain if he argues that a strong feature will be a clean and healthy entertainment, good class films, and—wise man—that the proceeds of the day will be entirely devoted to a local charity in which the opener is particularly interested. Having obtained his opener, he sends a well-printed and high-class looking invitation card "requesting the honour of the company of Lord and Lady——(or other notabilities) to support 'T. B. Windbag, Esq., M.P.,' on the occasion of the opening of the Grand Electric Empire, etc., etc.," not forgetting the "R.S.V.P.," so that he can invite others if there is a deficiency in the number of replies. Having been successful in this direction, the next step is to have everything complete and ready for the momentous event. Now this is where the manager must shine. He must hustle the various workmen and yet see that no portion of their work is stinted or badly finished, but in this hustling he must look well ahead, clearing everything at least a day before the opening, for he will find many little details needing attention at the last moment.

We take it that the building is all he desires ; it complies with the necessities of the local council, the Cinematograph Act and the police requirements. It possesses an excellent lobby and waiting rooms, the rake of the floor has been judiciously arranged at the approved slope of one in ten, and the walls are ready for the final decoration.

It is here that artistic taste is necessary so that there is a general appropriateness in the embellishment right through the building. The first consideration is the lobby, which has to be depended upon to create the best impression in the minds of patrons. A dingy lobby betokens in the thoughts of many a dingy entertainment. How often the mistake is made that all the public expect for outside appearance is a blaze of light. The wise picture theatre manager knows this is far from the case, and will see that the embellishments and adornments are neither garish nor glaring.

Nothing short of eighteen feet should be devoted to the lobby. Nor is this waste space, for it enables an advertising display to be made to advantage, and the passer-by who stops to read the program boards or day bill is well against the pay box before he or she realises that their curiosity has already got him or her almost inside the theatre.

The floor should be of tile or cement, and care must be taken to see that it is swept and washed at least once, if not twice a day. Greater variety of material is permitted in walls and ceiling. As a general thing, plaster casting is to be preferred to imitation marble ; and if tastefully done, finished in white and gold, and kept always fresh by the plentiful use of white paint and gold foil as required, such plaster casting will have a very good effect indeed.

The lighting should be brilliant, but not dazzling, and plants and shrubs—which should be carefully tended and watered, and full of life—not faded and dead, to convey the impression that the show is also half-dead—should be placed in suitable positions out of the way of the traffic.

The many excellent frames, easels, and advertising devices put on the market by such firms as the Tress Company, the Tyler Apparatus Company, Walturdaw Company, and many others, make it possible for the manager to give an interesting and attractive display in an unobtrusive fashion. The gaudy, bloodthirsty posters issued by some of the Continental and American makers are to be avoided in the better-class neighbourhoods, and the manager must see that his announcements are not an exaggeration of his program, or disappointment will "kill off" those who might become regular patrons.

The pay box—that important feature of the lobby—like the announcements, must not be too obtrusive. People must be attracted inside the lobby and incidentally pay their entrance money before they know they are off the pavement. At this latter and most important department, the manager must adopt a careful system of money taking, and when adopted, see that it is carried out in every detail. If a ticket-issuing machine is used, it must be frequently examined and checked, and the manager should constantly pop in and see that his instructions are being minutely carried out. The weekly statement sheets published at the offices of the KINEMATOGRAPH WEEKLY give a comprehensive scheme of account adjustment, and if used in combination with the Harper Ticket Issuing and Recording Machine, or some other suitable check issuer, they make this part of the manager's task easy—if only he religiously adheres to the work of attending to them at a fixed time each morning.

In too many of the theatres, spectators are treated to currents of cold air falling on their shoulders and making them so uncomfortable as to discourage them from returning. A waiting room, however, obviates this, and it should be adjoining the lobby. Also with the present system of continuous performance and of allowing anyone to enter or leave the auditorium while the picture is on the screen, many devotees deeply interested in a scene have either to move to allow someone to pass in front of them, or to have some newcomer masking the view while looking for a seat. A waiting or ante-room again proves a genuine remedy to this drawback, as the ushers would allow no one either to enter or leave the auditorium while a picture is on the screen.

And now, having passed through the entrance and waiting room, we enter

THE AUDITORIUM.

The brilliancy of the outside and lobby here gives way to a somewhat dark and sombre interior. But even though in many existing halls the colouring of the walls and upholstery may be rather grave, perhaps almost to depression, there is no reason why the hall should not be suitably and artistically decorated, so that when the lights are up the audience are impressed with their surroundings.

In a light coloured theatre, the light of the machine naturally reflects on the cream coloured walls, and from them back on the curtain, and many exhibitors not acquainted with this fact blame the operator for a bad light. An experienced operator may suggest some colour effects that would suit a particular house better than our present general suggestions, but at least we can say avoid glaring contrasts of colours and vivid hues, and kill the man who wants to put a couple of pounds of gold leaf on the walls. Light greens, blues or pinks, with a deeper tint in the shadow, would work well, as will a French grey worked up with a very little white. Two shades of the same colour are to be preferred to contrasting colours, but the great requirement for a moving picture theatre is that the paint shall be flat. It is not enough that it is said by the makers to be flat. If there is the slightest gloss it will cause cross reflections. Have the walls sand-papered.

A light tint that will economise lighting current and an 8 c.p. lamp will be as effective as your 16 c.p. in an auditorium done in deep red or brown. In some cases, tinted globes to match the colour scheme will be striking, and for present purposes the tinting had better be done at home. If you are careful not to get the colour on too thick the diminution of light will not be excessive. You can obtain electric lamp globe lacquering solution of almost any colour. In most cases, the solution should be used far thinner than the directions indicate, since you merely wish to tint your light, not to use the lamps for direct display.

A good plan for a dark colour scheme is to have the panels in a rich red border, with a border of a still darker shade, and have all the plastic ornaments painted imitation walnut or mahogany. You will then have one of the richest interiors that you can wish. When you use green for your colours and borders, you can have the plastic ornaments in either walnut or ebony colour. With brown coloured walls, the plastic ornaments may well be imitation old gold or old oxidised silver ; this combination would produce a rich and tasteful interior.

For floor covering, it is becoming increasingly universal to use a good carpeting instead of linoleum. There is something in the feel of a velvet pile that sub-consciously suggests and conveys the impression of luxury. It is hard to keep clean on muddy days, but it is worth the care, and if you can afford it, it will pay. If carpet is too expensive for the character of the house, use linoleum in solid colours for the aisles, and have the rest of the floor of bare hardwood, well waxed, but not to the point of slipperiness. Keeping the floor clean will then be a comparatively easy matter.

The Seating and Fittings.

There is only one form of seating that is worthy of consideration, and that is the tip-up ; but there are tip-ups and tip-ups ! The

market has been flooded with a kind of gaspipe arrangement which sells at four shillings, but beware of these and go to a reputable firm who will supply seats which will stand the wear and tear, and you will gain in the end. Among the many firms specialising in suitable seating are Messrs. J. S. Lyon and Company, Lazarus and Company, Hampton and Company, Maple and Company, Whiting and Bosisto, the Premier Seating and Electrical Company, City Wholesale Cabinet Works, Duffield and Company, A. R. Dean, Ltd., etc., etc.

It is well to have a centre, as well as two side aisles where floor area permits. The sides can be used for entrance and the centre for exits. Give as much space as possible between the rows of seats, from 2ft. 6in. to 3ft. is a fair distance. The number of seats in a row is, of course, dependent on the width of the hall.

The upholstery should be in keeping with the other decorations, and a point should be made of having the seats and hangings carefully brushed each morning before the hall is swept out.

Heating and Ventilation.

These are two important points which many a manager overlooks. If hot water pipes—the acme of perfect heating—are too expensive, an excellent substitute will be found in the gas steam radiators now so much in evidence at our places of amusement. They have the preliminary advantage of a good reputation, being much in use and very effective in their results. A big mistake is made in having the hall too hot. People get sleepy and languid, lose interest in the pictures and refuse to budge. You don't want them to occupy a comfortable seat for the whole evening, and you don't wish them to say the pictures (for it is always the pictures which get the blame) gave them a fearful headache.

With regard to ventilation, too, many a manager thinks that by creating a draught with a fan he is ventilating the hall, but he is really only stirring up dust and other trouble. The best plan is to go to a firm specialising in ventilation and let them handle the problem in a systematic and professional manner. Such firms as the British Westinghouse Company, the Sturtevant Engineering Company, the General Electric Company, etc., specialise in ventilation systems for buildings. Now we have the hall, the lobby and fittings, the seating, ventilation, heating, and naturally the next item of importance is

The Screen and Proscenium.

Time and again have we been asked to advise as to the best material for the former important fitting of the hall, and, of course, we have been solicited to give an opinion on patented screens, which would be difficult to touch upon in this work. No screen at all is wanted if you have a good, solid even wall, properly treated and kept

clean, but if you do have a screen, mind you get one of even texture, and see that it is hung tautly. Many firms specialise in screens, including the Tyler Apparatus Company, the Walturdaw Company, Bulman and Partners, New Things, Ltd., Wilmot, Barnard and Company, etc.

A screen, however, which is in front of the people all the time must be something more than the bare white material on which the films are to be presented. It should have an ornamental and artistic bordering or curtain, with a row of plants at the foot, or grouped artistically at each side. The best plan is to fix upon the amount you can spend on plants for this and the lobby, and let the local florists tell you the best they can provide at this figure. Of course, if you can get them to do it in exchange for an advertisement in your program or notices, saying "the Plants and Floral Decorations are provided by—" so much the better.

It is incumbent on the manager to get the best terms on his fire policies, and to do this he should instal some of the approved automatic fire sprinklers, hand grenades and fire buckets. Not only does he effect economy on his insurance by so doing, but the public are impressed by the precautions taken on their behalf.

Disinfecting the Theatre.

Another feature which must not be lost sight of is the thorough daily sweeping and cleansing of the theatre and its fittings. Very much depends on this, and also upon the use of disinfectants. For removing dust, nothing is better than one of the forms of vacuum cleaner now on the market. Then, too, there are patent circular brush brooms, as instance the "Bissell," and many others.

With regard to disinfectants, do not allow the use of strong smelling, over-advertised materials, but use those which are really capable of killing the bacteria and obnoxious putrefactive organisms always deposited where people most do congregate.

The frequent spraying, too, of some of the scented disinfecting essences not only helps in purifying the air, but the audience prefers the flavour to the moist, perspiring odour only too frequently found in our theatres. Among the devices for spraying may be mentioned the vaporizer of the Tyler Apparatus Company. Some excellent essences are manufactured for the purpose by F. J. Hyam, of Finsbury Pavement.

How to Advertise.

Our remarks here must, of necessity, be of a limited nature, for the field of possibilities can only be covered by an entire work on the subject. The tactful and economic manager may be content with a brilliant front and his personality to assist in making regular friends and patrons of those who may be attracted inside by the exterior show.

But more than this is needed now that competition is so keen, and halls are continually opened within a stone's throw of each other. Local advertising is always more or less of a gamble, and before advertising in the local press, posting the hoardings, or putting out sandwich men, the wise manager will weigh up every argument for and against each means of making his theatre known, and only indulge in those likely to bring results to the box office. If he is advertising in the local press, he should get all the news pars, puffs and write-ups it is possible to obtain ; if posting bills on the hoardings, he should not be content with the billposters' display, but see that only the best positions are utilised for his announcements and if sandwich men are employed, give them definite stations to be found at—not too near the public houses, for unless looked after carefully, more than half the time of these individuals will be spent at the bar.

One suggestion we make which, as the result of practical experience should be of value to those managers who have not adopted it. This is, that every now and then, say once a month, an exceptional film subject should be boomed as a special attraction. No matter who supplies the film service, or on what basis it is arranged, some presumably rather extraordinary film of the startling kind now so often announced in the KINEMATOGRAPH WEEKLY should be made much of, and it should be presented with special music and effects, and featured as a star attraction. This is a fine paying advertising instrument, when carried out with proper preparations and announcement.

Another excellent method of keeping the public anxious to patronise the show is occasionally to present some sort of souvenir, which thus forms a permanent advertisement. Novelties which are shown to friends because of their ingenuity ; illustrated booklets which are taken home, and though inexpensive, are too good to throw away ; picture postcards, and many other souvenirs are sprats to capture shoals of mackerel, and the wise manager will ever be on the *qui vive* to discover attractions in this direction.

PROGRAMS, SWEETS AND TEAS.

A program may cause a manager a good deal of work, but it should not only become a paying proposition but a useful advertiser if made attractive enough for the patron to take away with him. Brief synopses of the films, taken from the KINEMATOGRAPH WEEKLY, make excellent reading, and materially help the story of the pictures, and add to the attractiveness of the program. Photographs of the actors, too, can now be obtained from the film makers, and if used in a program create a lively interest in the pictures.

The sale of chocolates and sweets is a profitable addition to the returns if properly managed, and the inducement of a cup of *good* tea leads many to visit the show who would not enter for the pictures alone.

The Staff and Officials.

Great discretion should be used by the manager in engaging those who are to assist him in running the hall, and a careful and comprehensive agreement—not of too legal a nature—is essential if matters are to run smoothly.

We start first with that important, dignified and conspicuous individual, the doorman, generally a huge commanding specimen of manhood, resplendent in, say, blue and gold, who in stentorian tones announces the "special" now showing, and in grandiose manner directs his "captures" to the ticket office. A good man on the door is one of the greatest acquisitions to the hall, and his duties do not end at the entrance, for in the morning he takes his share in the cleaning up, and as the last to leave at night, it is he that sees everything is O.K. before finally locking the front door. His salary is anything from 25s. to 50s. weekly, including uniform.

The cashier or pay box attendant is generally a lady of more or less fascinating appearance and businesslike methods. She must be quick at handling the cash, on the watch for bad coins, and able to fill up the cash forms and slips at the end of each day. Her weekly wages run from 12s. 6d. to £1, and considering the many cases where she handles quite a goodly sum, her salary is not too remunerative.

Then at the door of the auditorium we run across the check taker, chucker-out, messenger and general utility man. He is also in uniform of a more subdued nature than our friend, the doorman, however. He must be courteous and responsive to the many questions continually thrust at him by those entering or leaving the theatre, and 25s. is his average weekly wage.

Once inside, the seat attendants, with their electric torches, conduct us to our places, and their neat costumes and smart appearance do much to keep up the prestige of the house. They must be sufficiently attractive to be in keeping with the general style of the show, but not so attractive as to warrant flirtation with every youth who enters into conversation with them. If love making is allowed to start it seems contagious, and the manager will find all his work cut out to prevent every member of the staff giving more attention to the pastime than to the work they were engaged for.

In many halls, the attendants sell programs and sweets, and add to their 10s. or 15s. weekly wage by a commision given on their sales.

It will be seen from this chapter that the manager's job is no sinecure. He must be ever on the spot, at the beck and call of his assistants ; ever on the alert for improvements in the performance ; ever courteous to his numerous patrons, and ever in possession of a manner calculated to surmount the many difficulties which continually crop up, even in the best regulated picture show.

CHAPTER IX.

THE LAW AND THE KINEMATOGRAPH.

Until the passing of the Cinematograph Act in 1909, which came into operation January 1st, 1910, the picture showman had a fairly free hand in the conduct of his performances, but the powers which this act gave to the various councils caused very stringent regulations to be put into force, which, as circumstances and necessities have arisen, have been materially added to and altered. In the following pages we have not attempted to deal *in extenso* with the Act itself, but have condensed the most important and essential points.

What is the Cinematograph Act, 1909?

The Act primarily is to make better provision for securing safety at kinematograph exhibitions, and first *provides against any motion picture exhibition for which inflammable films are used, elsewhere than in licensed premises,* and unless the regulations of the Secretary of State for securing safety are complied with.

It gives power to the county councils to *grant yearly licenses* for that object, and to *transfer such licenses.* The applicant for the license or transfer must give seven days' notice in writing to the county council or chief police officer. The county council may grant, or renew transfer, and may fix their charges at an amount not exceeding £1 for a year, or in the case of a grant or renewal for any less period, 5s. for every month for which it is granted.

The Penalties.

The penalty if the owners use or allow to be used (or if the occupier of any premises allows to be used) the premises contrary to the provision of the Act, i a fine not exceeding £20, and in the case of continuing the offence, a further penalty of £5 each day, and the license may be revoked.

Inspection of Premises.

The Act gives power to an officer appointed for the purpose to enter the premises at reasonable times to see that the provisions of the Act are complied with.

Delegation of Powers to other Authorities.

The council may delegate its powers to justices sitting in petty sessions.

No License for Occasional Use.

It is not necessary to obtain a license for premises used only six days in a year for a kinematograph show, but notices of such

occasional shows must be given to the county council or chief police officer, and these shows must conform with the regulations.

Licensing Travelling Showmen.

Performances may be given in movable structures without a license from the council of the county in which the performance is to take place, as long as a license in respect of that building has been obtained from the council of the county in which the owner ordinarily resides, but two days' notice must be given to the council or chief police officer, and the regulations must be complied with.

The Regulations of the Secretary of State.

Thus, the Act vested the Secretary of State with powers to make and enforce regulations to provide for safety in kinematograph exhibitions. The first set of regulations was issued from the Home Office on December 20th, 1909, but these were amended and repealed on February 18th, 1910, and these latter we give *in extenso.*

General.

1. In these regulations the word " building " shall be deemed to include any booth, tent, or similar structure.

2. No building shall be used for kinematograph or other similar exhibitions to which the Act applies, unless it be provided with an adequate number of clearly indicated exits so placed and maintained as readily to afford the audience ample means of safe egress.

The seating in the building shall be so arranged as not to interfere with free access to the exits ; and the gangways and the staircases, and the passages leading to the exits shall, during the presence of the public in the building, be kept clear of obstructions.

3. The kinematograph operator and all persons responsible for or employed in or in connection with the exhibition shall take all due precautions for the prevention of accidents, and shall abstain from any act whatever which tends to cause fire and is not reasonably necessary for the purpose of the exhibition.

Fire Appliances.

4. Fire appliances adequate for the protection of the building shall be provided, and shall include at least the following, namely, a damp blanket, two buckets of water, and a bucket of dry sand. In a building used habitually for the purpose of kinematograph or other similar exhibitions they shall also include a sufficient number of hand grenades or other portable fire-extinguishers.

The fire appliances shall be so disposed that there shall be sufficient means of dealing with fire readily available for use within the enclosure. Before the commencement of each performance, the kinematograph operator shall satisfy himself that the fire appliances intended for use within the enclosure are in working order, and during the performance, such appliances shall be in the charge of some person specially nominated for that purpose who shall see that they are kept constantly available for use.

Enclosures.

Regulations applying in all cases and to all classes of buildings.

5.—(1) (*a.*) The kinematograph apparatus shall be placed in an enclosure of substantial construction made of or lined internally with fire-resisting material and of sufficient dimensions to allow the operator to work freely.

(*b.*) The entrance to the enclosure shall be suitably placed and shall be fitted with a self-closing close-fitted door constructed of fire-resisting material.

(*c.*) The openings through which the necessary pipes and cables pass into the enclosure shall be efficiently bushed.

(*d.*) The openings in the front face of the enclosure shall not be larger than is necessary for effective projection, and shall not exceed two for each lantern. Each such opening shall be fitted with a screen of fire-resisting material, which can be released both inside and outside the enclosure so that it automatically closes with a close-fitting joint.

(*e.*) The door of the enclosure and all openings, bushes and joints shall be so constructed and maintained as to prevent, so far as possible, the escape of any smoke into the auditorium. If means of ventilation are provided, they shall not be allowed to communicate direct with the auditorium.

(*f.*) If the enclosure is inside the auditorium, either a suitable barriers hall be placed round the enclosure at a distance of not less than two feet from it, or other effectual means shall be taken to prevent the public from coming into contact with the enclosure.

(*g.*) No unauthorised person shall go into the enclosure or be allowed to be within the barrier.

(*h.*) No smoking shall at any time be permitted within the barrier or enclosure.

(*i.*) No inflammable article shall unnecessarily be taken into or allowed to remain in the enclosure.

Regulations applying only to specified classes of buildings.

(2) In the case of buildings used habitually for kinematograph or other similar exhibitions, the enclosure shall be placed outside the auditorium ; and in the case of permanent buildings used habitually as aforesaid the enclosure shall also be permanent.

Provided, with regard to the foregoing requirements, that, if the licensing authority is of opinion that compliance with either or both of them is impracticable or in the circumstances unnecessary for securing safety and shall have stated such opinion by express words in the license, the requirement or requirements so specified shall not apply.

LANTERNS, PROJECTORS AND FILMS.

6. Lanterns shall be placed on firm supports constructed of fire-resisting material, and shall be provided with a metal shutter which can be readily inserted between the source of light and the film-gate.

The film-gate shall be of massive construction and shall be provided with ample heat-radiating surface. The passage for the film shall be sufficiently narrow to prevent flame travelling upwards or downwards from the light-opening.

7. Kinematograph projectors shall be fitted with two metal film-boxes of substantial construction, and not more than fourteen inches in diameter, inside measurement, and to and from these the film shall be made to travel. The film-boxes shall be made to close in such a manner, and shall be fitted with a film-slot so constructed, as to prevent the passage of flame to the interior of the box.

8. Spools shall be chain or gear driven and films shall be wound upon spools so that the wound film shall not at any time reach or project beyond the edges of the flange of the spool.

9. During the exhibition all films when not in use shall be kept in closed metal boxes.

LIGHTING.

10. Where the general lighting of the auditorium and exits can be controlled from within the enclosure, there shall be also separate and independent means of control outside and away from the enclosure.

11. No illuminant other than electric light or limelight shall be used within the lantern.

Electric Light.

12.—(*a.*) Within the enclosure the insulating material of all electric cables, including " leads " to lamps, shall be covered with fire-resisting material.

(*b.*) There shall be no unnecessary slack electric cable within the enclosure. The " leads " to the kinematograph lamp shall, unless conveyed within a metal

pipe or other suitable casing, be kept well apart both within and without the enclosure and shall run so that the course of each may be readily traced.

(*c*.) Cables for kinematograph lamps shall be taken as separate circuits from the source of supply and from the supply side of the main fuses in the general lighting circuit, and there shall be efficient switches and fuses inserted at the point where the supply is taken, and in addition, an efficient double-pole switch shall be fitted in the kinematograph lamp circuit inside the enclosure. When the kinematograph lamp is working, the pressure of the current across the terminals of the double-pole switch inside the enclosure shall not exceed 110 volts.

(*d*.) Resistances shall be made entirely of fire-resisting material, and shall be so constructed and maintained that no coil or other part shall at any time become unduly heated.* All resistances, with the exception of a resistance for regulating purposes, shall be placed outside the enclosure, and if reasonably practicable, outside the auditorium. If inside the auditorium, they shall be adequately protected by a wire guard of other efficient means of preventing accidental contact.

The operator shall satisfy himself before the commencement of each performance that all cables, leads, connections and resistances are in proper working order. The resistances, if not under constant observation, shall be inspected at least once during each performance. If any fault is detected, the current shall be immediately switched off, and shall remain switched off until the fault has been remedied.

Limelight.

13.—(*a*.) If limelight be used in the lantern the gas cylinders shall be tested and filled in conformity with the requirements set out in the Appendix hereto. The tubing shall be of sufficient strength to resist pressure from without and shall be properly connected up.

(*b*.) No gas shall be stored or used save in containers constructed in accordance with the requirements contained in the Appendix.

LICENSES.

14. Every license granted under the Act shall contain specific conditions for the carrying out of regulations 2 and 5 (1) (*a*), (*b*), (*c*), (*d*), (*e*), (*f*) in the building for which the license is granted, and may in accordance with the regulation 5 (2), contain an expression of opinion on the matters referred to in the proviso thereto.

15. Subject to the provisions of No. 16 of these regulations, every license granted under the Act shall contain a clause providing for its lapse, or, alternatively, by its revocation by the licensing authority, if any alteration is made in the building or the enclosure without the sanction of the said authority.

16. Where a license has been granted under the Act in respect of a moveable building, a plan and description of the building, certified with the approval of the licensing authority, shall be attached to the license. Such a license may provide that any of the conditions or restrictions contained therein may be modified either by the licensing authority or by the licensing authority of the district where an exhibition is about to be given. The license and plan and description or any of them shall be produced on demand to any police constable or to any person authorised by the licensing authority or by the authority in whose district the building is being or is about to be used for the purpose of an exhibition.

17. The regulations dated December 20th, 1909, made under the Cinematograph Act, 1909, are hereby repealed, provided, nevertheless, that any license granted prior to such repeal shall remain valid for the period for which it was granted without the imposition of any more stringent condition than may have been imposed at the time of the grant.

**e.g., they shall not become so heated that a piece of newspaper placed in contact with any part of the resistance would readily ignite.*

APPENDIX.

LIMELIGHT.

The gas cylinders shall be tested and filled in conformity with the requirements set out below, which follow the recommendations of the Departmental Committee of the Home Office on the Manufacture of Compressed Gas Cylinders (C. 7952 of 1896.) :—

Cylinders of Compressed Gas (Oxygen, Hydrogen or Coal Gas.)

(*a*) *Lap-welded wrought iron.*—Greatest working pressure, 120 atmospheres, or 1,800 lbs, per square inch.

Stress due to working pressure not to exceed 6½ tons per square inch.

Proof pressure in hydraulic test, after annealing, 224 atmospheres or 3,360 lbs. per square inch.

Permanent stretch in hydraulic test not to exceed 10 per cent. of the elastic stretch.

One cylinder in fifty to be subjected to a statical bending test, and to stand crushing nearly flat between two rounded knife-edges without cracking.

(*b*) *Lap-welded or seamless steel.*—Greatest working pressure, 120 atmospheres, or 1,800 lbs. per square inch.

Stress due to working pressure not to exceed 7½ tons per square inch in lap-welded, or 8 tons per square inch in seamless cylinders.

Carbon in steel not to exceed 0.25 per cent. or iron to be less than 99 per cent.

Tenacity of steel not to be less than 26 or more than 33 tons per square inch. Ultimate elongation not less than 1.2 inches in 8 inches. Test bar to be cut from finished annealed cylinder.

Proof pressure in hydraulic test, after annealing, 224 atmospheres, or 3,360 lbs. per square inch.

Permanent stretch shown by water jacket not to exceed 10 per cent. of elastic stretch.

One cylinder in fifty to be subjected to a statical bending test, and to stand crushing nearly flat between rounded knife-edges without cracking.

Regulations applicable to all Cylinders.

Cylinders to be marked with a rotation number, a manufacturer's or owner's mark, an annealing mark with date, a test mark with date. The marks to be permanent and easily visible.

Testing to be repeated at least every two years, and annealing at least every four years.

A record to be kept of all tests.

Cylinders which fail in testing to be destroyed or rendered useless.

Hydrogen and coal gas cylinders to have left-handed threads for attaching connections and to be painted red.

The compressing apparatus to have two pressure gauges, and an automatic arrangement for preventing overcharging. The compressing apparatus for oxygen to be wholly distinct and unconnected with the compressing apparatus for hydrogen and coal gas.

Cylinders not to be refilled till they have been emptied.

If cylinders are sent out unpacked the valve fittings should be protected by a steel cap.

A minimum weight to be fixed for each size of cylinder in accordance with its required thickness. Cylinders of less weight to be rejected.

NON-INFLAMMABLE FILMS.

It will be seen, therefore, that where non-inflammable film is used, the Act and Regulations in no way apply ; and in several cases this point has been tested, but the results have not been entirely satisfactory, as the onus of proving that the film was *in no way inflammable* was fixed on the user, who, in several instances, failed to prove conclusively to the magistrates that the film *would not burn.*

APPLICATIONS FOR LICENSES.

The following is the form used in applying for a license.

ADMINISTRATIVE COUNTY OF LONDON.

CINEMATOGRAPH ACT, 1909 (9 Edw. VII., Ch. 39).

APPLICATION FOR LICENSE

	................................., 19....
(*a*) *Insert Christian name and surname of applicant.*	I, the undersigned, (*a*)... residing at (*b*)... (*c*)...
(*b*) *Insert place of residence.*	hereby give notice that at the expiration of seven days I intend to apply for a License for a Kinematograph Exhibition to be carried on within the premises called or known
*(*c*) *State whether applicant is occupier of the premises or owner of apparatus.*	as... and situated at... in the Metropolitan Borough of... and in the Metropolitan Police District of (*d*)..................
(*d*) *Insert letter of Police Division.*	The Exhibition to be held for a period of............... commencing on....................................

....

Signature of Applicant.

To

The Clerk of the London County Council,
County Hall,
Spring Gardens, S.W.

* Except in the case of an occasional license the application must be made by the occupier of the premises. Where the premises are in the occupation of a company or syndicate the application should be made by the Secretary or Manager and the address of the registered offices of the company should be stated.

NOTE.—*Notice should be given to the Commissioner of Police of the Metropolis, New Scotland Yard, S.W., or if the premises sought to be licensed are situated within the City of London, to the Commissioner of Police for the City of London,* 26, *Old Jewry, E.C.*

We give hereunder the form in which the license is granted :—

ADMINISTRATIVE COUNTY OF LONDON.

Cinematograph Act, 1909 (9 *Edw. VII., Ch.* 30.)

WHEREAS...
of...
has duly given the notices prescribed by sub-section 4 of section 2 of the Cinematograph Act, 1909, the London County Council, in pursuance of the provisions of section 2 of the said Act, hereby grants this Licence to the said.................. ....to use the premises called or known as..................... ....and situated at..............................

for the exhibition of pictures or other optical effects by means of a kinematograph or other similar apparatus for the purposes of which inflammable films are used. Such exhibition to be subject to the regulations of the Secretary of State for securing safety and on the terms and conditions and under the restrictions following, viz.—

1. That the period during which such license shall remain in force shall be............................from the..................................day of ...., 19..., unless previously revoked in pursuance of the provisions of the above-mentioned Act.

2. That the premises be not opened on Sundays, Christmas Day or Good Friday for kinematograph entertainments.

3. That in the event of any alteration being made in the building or enclosure without the sanction of the Council having been first obtained the license will be liable to be revoked by the Council.

4. That all the exits be indicated by notices clearly painted to the satisfaction of the Council over the doors or openings at a height of at least 6 feet nine inches above the floor.

5. That each exit door or opening do have a distinct light fitted over it to illuminate the exit notice, and that such light be on a different system from the main lighting of the building, and be maintained throughout the performance.

6. That all exitways, corridors, passages and staircases affording means of egress from the premises be efficiently lighted by two independent systems of lighting during the whole time the public are on the premises.

7. That all exit doors, if fastened during the time the public are in the building, be secured during such time by automatic bolts only of a pattern and in a position to be approved by the Council, and do have a notice clearly painted on them indicating the method of opening.

8. That the management do allow the public to leave by all exit and entrance doors, which must open outwards.

9. That the seating be set out so that there shall be a space of at least 1 foot in depth between the front of one seat and the back of the next measured between perpendiculars and that where chairs are used they be battened together in lengths of not less than 4 or more than 12 chairs.

10. That all curtains covering doors or in passages be hung on sliding rings and so as not trail on the ground and be parted in the centre.

11. That persons be not permitted to stand or sit in any of the intersecting gangways, and, if standing be permitted in the gangways at the sides and rear of the seating, sufficient room be left for persons to pass easily to and fro.

Picture Shows on Sunday.

The London County Council, having been given power to enforce these Regulations of the Secretary of State, were bold enough to take full advantage of Clause 2 of the Act, which states that they "may grant licenses to such persons as they think fit to use the premises specified in the license for the purposes aforesaid *on such terms and conditions and under* such restrictions as, subject to regulations of the Secretary of State, the Council may by the respective licenses determine."

Sunday was one of the most profitable days the showman had, and representations were made and much discussion took place until finally the London County Council issued the following manifesto, which naturally sets the precedent for other licensing bodies to follow.

LONDON COUNTY COUNCIL.

SUNDAY CINEMATOGRAPH ENTERTAINMENTS.

The Council on 11th April, 1911, considered the question of Sunday entertainments at premises licensed by it for cinematograph exhibitions, and decided that applications for permission to use premises licensed by the Council under the Cinematograph Act, 1909, for Cinematograph Entertainments on Sunday or other days prohibited by the license, be considered only when the entertainments will be given by recognised societies or organisations unconnected with the premises concerned, and only when accompanied by a copy of the agreement between the licensee and the society or organisation proposing to give the entertainments, and by a joint undertaking, signed by the licensee and by a responsible officer of the society or organisation in question, to the effect that :—

1. The entertainments will be of a healthy and elevating character, and properly conducted and not for private gain or by way of trade.

2. The name of the society or organisation giving the entertainments will be exhibited in a conspicuous position outside the premises.

3. No performance shall begin before 6 p.m., or finish later than 11 p.m.

4. The licensee or his servants will have nothing to do with the arrangements for the entertainments, (*e.g.*, the engagement of operators or employees) beyond being responsible to the Council for the observance of its regulations.

5. No person shall be employed on Sunday who has been employed in connection with the cinematograph entertainments for each of the previous six days.

6. The society or organisation will by its duly appointed representative pay to each employee his or her wages for the Sunday, and such representative shall not be the licensee or any of his employees, or any person officially connected with the licensed premises.

7. The signature of each employee will be obtained each Sunday by the duly appointed representative of the society or organisation giving the entertainments to a wages sheet containing the following particulars : names and addresses of the employees, the capacity in which each serves, the wages for the week, excluding Sunday, the agreed wages for the Sunday, and a statement that each employee works voluntarily on the Sunday and without pressure from the management and such wages sheet must be signed when completed by the representative of the society or organisation.

8. An audited balance sheet giving full details of the receipts and expenditure for each Sunday will be submitted to the Council by the representative of the society or organisation giving the entertainments at the end of each four weeks, and there shall be forwarded with the balance sheets the wages sheets referred to in condition (7).

9. The rules required to be observed on week days for securing the safety of the audience will be complied with.

10. The licensee and the heads of the society or organisation will hold themselves responsible for seeing that the undertaking given to the Council is adhered to.

In any case in which it appears from the agreement that the sum proposed to be paid for the hire of the hall is greater than is necessary to cover one-seventh of the weekly expenditure for rent, rates, taxes, etc., and the actual out-of-pocket expenses, such as cost of lighting and heating the premises, damage and depreciation to building, hire of films, etc., the application will be refused on

the grounds that the proposal is inconsistent with the condition that the entertainments shall not be for private gain or by way of trade.

In order, therefore, to enable the Council to come to a decision on an application, there should be forwarded with the copy of the agreement referred to above, a statement of the annual expenditure on rent, rates and taxes, on the lighting and heating of the premises, and on any other items covered by the payment to be made for the use of the premises.

Music in Picture Theatres.

Under an act of George II.—The Disorderly Houses Act—no musical entertainment can be given unless the premises have been duly licensed for that purpose.

Pictures require the enlivening influence of music to increase their attractiveness, and many showmen, on the plea that a piano or gramophone was a subsidiary part of the performance, introduced automatic musical instruments, only to find that the law quickly stepped in and prohibited their use. There is still a doubt as to the legal position, and the exhibitors who desire to keep clear of the "myrmidons of the law" would do well to save the expense of ultimate legislation, and apply to the licensing authorities for the license.

The form issued by the London County Council is as follows :—

ADMINISTRATIVE COUNTY OF LONDON.

MUSIC, MUSIC AND DANCING, AND STAGE PLAYS LICENSES.

APPLICATION FOR LICENSE.

(a) Insert "Music" or "Music and Dancing," or "Stage Plays".
(b) Insert Christian and Surname of applicant.
(c) Insert place of residence.
(d) In the cases of the City of London and the City of Westminster, strike out the words "Metropolitan Borough" and insert the word "City."
(e) Insert letter of Police Division.

FOR A (*a*)..LICENSE
..............................1911.

I, the undersigned, (*b*)..
of (*c*)...
hereby give notice that I intend to apply, under the provisions of the Statutes 25 Geo. II., chap. 36, or 6 and 7 Vict., chap. 68, and 51 and 52 Vict., chap. 41, to the London County Council for a License for (*a*)................................ ....to be carried on within the house or premises, situated at... and known as the...in the Metropolitan Borough of (*d*)................................ in the London County Council Electoral Division of......... and in the Metropolitan Police Division (*e*).................. and now in my occupation ; and I further give notice that such application will be made at a meeting of the Theatres and Music Halls Committee of the said Council, to be held on or about the 11th day of November next.

....
Signature of Applicant.

N.B.—The Council does not recognise any special agent or other intermediary in regard to applications made for licenses or the transfer of licenses. No charge is made by the Council in respect of any such application.

The license when granted, reads as follows :—

ADMINISTRATIVE COUNTY OF LONDON.

WE, THE LONDON COUNTY COUNCIL, at a Meeting holden in and for the said Administrative County of London, on the Twenty-fifth day of November, 1910, Do, by Virtue of the Power given us by the " Disorderly Houses Act, 1751 " (as amended by the " Public Entertainments Act, 1875 ") and " The Local Government Act, 1888 " HEREBY license... (hereinafter called the " Licensee ") to keep a certain House or Place called... .... in the said County for public MUSIC......................................to the end of the Meetings of the said Council, sitting for the purpose of granting and refusing Licenses, in the ensuing year of 1911. The Licensee to take care, as far as in h... lies, that no disorders be committed within the said House or Place, and that nothing contrary to Sobriety, Decency and Good Manners be exhibited, represented or transacted therein ; and that...he... do not suffer any of the aforesaid Entertainments after midnight ; and that ...he do not open the said House or Place on the Lord's Day (commonly called Sunday), nor on Christmas Day, Good Friday, nor on any day of Solemn Fast and Humiliation which now is or hereafter shall be by lawful authority appointed ; and ...he do in all things conduct the said House or Place decently, soberly, and orderly, according to the true Intent and Meaning of this License, and of the said Acts of Parliament. PROVIDED NEVERTHELESS that the Licensee, in order to give public Notice that the Said House or Place is so licensed as aforesaid, Do affix and keep up in some Notorious Place over the Door or Entrance thereof, an Inscription in Large Capital Letters in the words following :—" LICENSED PURSUANT TO ACT OF PARLIAMENT OF THE TWENTY-FIFTH OF KING GEORGE THE SECOND." AND provided LIKEWISE that the said House or Place so licensed as aforesaid shall not be opened for any of the said purposes on any Day whatever, before the hour of noon.

GIVEN under the Seal of the said Council at the said Meeting on the said Twenty-fifth Day of November, 1910.

....

Clerk of the Council.

By the Second Section of the " Disorderly Houses Act, 1751," it is directed that no Fee or Reward shall be taken for this License.

This License shall remain in force from its date to the end of the Meetings of the London County Council, sitting for the purpose of granting and refusing Licenses, in the next ensuing year of 1911.

Subject to the undertaking which I hereby give :—

AN AGREEMENT WITH THE MANAGER.

It is always advisable for all parties concerned that proprietors should have definite and concise agreements with managers, operators, and other employees. To use a stereotyped form of agreement is unwise, as the local requirements and individual needs in each case should be dealt with by a specially drawn agreement. As some guide to the form used, we give hereunder a form used by many companies:—

MANAGER'S AGREEMENT.

AN AGREEMENT made the...............................day of..................1911 between...of............................ (hereinafter called " the Company ") of the one part and............................. ....of...........................(hereinafter called " the Manager ") of the other part WHEREBY it is agreed as follows :—

1. The Company shall employ the Manager and the Manager shall serve the Company as working Manager of the Company's business carried on at ....for a period of..................calendar months from the........ day of............, and the Manager's employment may be determined on the ....day of............ next by either the Company or Manager giving to the other one calendar month's previous notice in writing. The Manager's remuneration shall be............per week payable weekly, the first payment to be made on the..................day of............... and the Manager shall also be entitled to a bonus of Five per centum of the net profits of the business divisible as dividends earned by the said company in each month and such bonus shall be paid within 5 days of the end of each month and the Certificate of the Company's auditor shall be conclusive evidence of the amount of such net profits and of the proportion thereof to which the Manager is entitled. The Manager shall be entitled to a proportional part of such bonus at the termination of his employment.

2. If at any time during his employment the Manager shall be guilty of misconduct or in any way whatever pledge the credit of the Company or shall neglect to give adequate time and personal attention to the said business or shall neglect to open punctually and carry on efficiently the entertainments to be given by the Company or shall fail to maintain good order and discipline amongst the staff and to keep the premises clean and in good order or shall neglect or disobey any lawful orders or directions of the directors then the directors may determine his employment without notice and without being liable for any claim for compensation by reason of such determination.

3. The Manager shall so far as possible personally attend to the said business at all times during the usual business hours and shall also personally exhibit as far as possible all pictures and films and shall give such attention to the working of the engine and other apparatus as is consistent with the efficient projection of the pictures.

4. Subject to such orders and directions as may from time to time be given to him by the directors through their Secretary (all which orders and directions the Manager shall promptly and faithfully obey observe and comply with) the Manager shall have the general control and management of the said business and of all persons employed in and about the same and shall use all proper means in his power to protect and further the interests of the Company PROVIDED THAT :—

(*a*) The Manager shall not engage any employee without the sanction of the Directors.

(*b*) No goods shall be ordered for or in the name of the said Company except upon the Company's printed order form countersigned by the Secretary and no goods shall be paid for by the Manager except such as may be authorised by the Directors to be paid for out of petty cash.

5. Upon the determination from whatever cause of his employment the Manager will not at any time or for any purpose use the name of the Company or any information concerning the Company to its detriment or so as to in any way injure the business of the Company.

6. In case the Manager is prevented by illness or personal accident from performing his duties and shall furnish the Directors with such evidence thereof as may be satisfactory to them he shall receive his salary in full for the first two weeks and half his salary for the two succeeding weeks during such incapacity and if he is incapacitated for longer than four weeks the Directors shall have power to determine his employment and he shall not be entitled to claim any compensation from the Company in respect of such determination.

AS WITNESS, etc.,

Is a License Needed for an Open Air Show?

In the Regulations, the definition of the term "building" is given as including "a booth, tent, or similar structure," therefore we

thought it advisable in the interests of the trade to take counsel's opinion as to whether the word ' premises ' could be made to include land in the sense of an open field. We regret to find that it does so and print below counsel's opinion to this effect.

> " In our opinion the Act is clear. A kinematograph exhibition may not (when inflammable films are used) be given elsewhere than in premises licensed for the purpose. The popular meaning of the word ' premises ' includes land, and if it did not an exhibition given on unlicensed land would certainly be given ' elsewhere than in premises licensed.' The fact that the regulations framed under the Act deal wholly, or, as we should say, chiefly with buildings, cannot qualify the Act. The requirements in the case of an open air exhibition may be merely nominal, but the need for the license is not dispensed with."

The Workmen's Compensation Act.

Showmen are responsible for accidents to employees who do not receive more than £250 per annum. This does not apply to casual workers, but it would apply to a woman who was engaged to clean windows, say, every Friday, because, being employed *every* Friday, the work is not casual. Further, the Act treats certain diseases arising in the course of employment as accidents. Fortunately, a very easy, and all things considered, economical solution is at hand in the form of insurance of employees.

The Children's Act, 1908.

There is only one section applying to showmen, and it is due, without doubt, to the fact that an accident happened from the faulty construction of a staircase. The section applying is 121, and is wedged into the statute. But it only applies where the majority of the audience are children, at which some, at least, reach their seats by way of a stair-case, and even then the children are to exceed one hundred in number, when three attendants should be provided for each hundred.

Is Lavatory Accommodation Compulsory.

Section 36 of the Public Health Act allows the local authority to require that the occupier or owner of a house which has not sufficient lavatory accommodation in the shape of water closets, shall provide such water closets. But the question is, what does the section mean by the term " house " ? Section 4 defines house to include schools, factories and other buildings *in which persons are employed.* One of the best text books states " it is presumed that the term would signify any building in which persons are employed." It is quite certain that persons are employed in places of entertainment, and the proprietors are bound to supply sanitary conveniences for such persons and also for artistes whom they may employ.

Showmen Liable for Accident to Patrons.

A showman is compelled to take every precaution for the care and safety of those visiting his show, but still accidents continue to happen. Here is a case which came recently to our notice :—A person, a woman, had been visiting a show, and upon leaving, stumbled over a step and fractured a leg. This step was in a side passage, and the passage was fairly well lighted. She stated it was not lighted at all ! She brought an action claiming £40 for injuries and £16 special damages ; four weeks at seaside, £10 ; new dress, £4 ; special nourishment, wine, beef tea, chicken, etc., £2. In all £56. Most motion picture shows are given in the dark, and the question is, under the circumstances, did the woman willingly expose herself to the risk of walking along a dark passage ? If she knew of the danger and ran into it of her own accord, she cannot recover. But this case is somewhat wider. The woman fell in a fairly well-lit passage. Moderate lighting is a wise precaution, because if too well lit, a person coming out of the show into a sudden glare cannot see at all—is really more or less blind for a few moments. Accidents often happen from such causes. Before she could recover she must prove that the showman was negligent. If the case went for trial, the showman's possible negligence would be that he did not station an attendant at the top or near the step to call out : "Mind the step."

How Long may Films be Retained on Approval.

Manufacturers of film subjects have had many abuses played upon them by unscrupulous showmen. One of the worst is obtaining films on approval, making use of them for show purposes and returning them in three or four days as not suitable for their requirements. This treatment has caused several County Court actions, and in these the general opinion has been expressed that films retained for more than twenty-four hours have been purchased. Judge Woodfall, however, stopped a case in February, 1910, brought by the Nordisk Films Company against the New Film Hiring Company, Limited. He considered the case rested on two alternative grounds : whether the film sent on the Saturday and not returned on the Monday constituted a sale, or whether there was a clear case of sale at any time. He admitted the sending back of certain films was in the plaintiff's favour, but as the managers of the defendant company had both denied buying, he must assume the other alternative, viz., the acceptance by the time the film was kept. To that His Honour contended no evidence had been given to prove that such a custom prevailed, and that *the twenty-four hours' approval limit was not binding without an individual contract being entered into* and was honoured as much in the breach as in observance.

Does a Picture Show constitute a Factory.

Several summonses have been taken against showmen under the Factory and Workshops Act. In one case at Burnley, a visitor

entered the room where the proprietors generate their own electric supply, and became entangled in the machinery with fatal results. The summons was brought under the Factory and Workshops Act, the prosecution contending that the premises came within the scope of that measure on account of the arc lamps overhanging the streets. The Home Office inspector explained that an engine used to generate electricity for the purpose of lighting a public place, street, or thoroughfare, came within the meaning of the Act. The company denied that on the night the accident happened, the arcs were lit, and eventually the case was dismissed on payment of costs. As a matter of fact, there is no doubt that where generating sets are used, the Factory Act applies. In the case of shows where motor generators (or transformers) are installed, however, we have thought it worth while to be at some considerable trouble to get the authoritative opinion of the Home Office as to how such shows stood with regard to the Factory Act.

In the end and after the customary delay and red tape which was to be expected in a direct appeal to the head authority, we have been successful in our efforts. Moreover, the true state of the case as regards showmen installing motor generators turns out to be particularly interesting. It is this :—

Where the convertor is used for transforming down for the kinematograph arc only it does not place the show under the Factory Act.

Where used for general hall or show front lighting in addition to supplying current for the projection arc, a rotary convertor does bring the showman under the factory regulations.

FIG. 184. POSING FOR THE CAMERA IN EAST AFRICA.

Printed and Published
by
E. T. HERON & Co.,
9-11 Tottenham Street,
London, W.

1912.

Size of Carbons for Projector Arcs.

CONTINUOUS CURRENT.

CURRENT IN AMPS.	LOWER SOLID CARBON	TOP CARBON CORED
10-15	10 m/m	13 m/m
15-25	12 ,,	16 ,,
25-40	13 ,,	18 ,,
35-50	14 ,,	20 ,,
40-60	16 ,,	22 ,,
60-100	18 ,,	25 ,,

ALTERNATING CURRENT.

CURRENT IN AMPS.	TOP AND BOTTOM CARBONS BOTH CORED
15-25	10 m/m.
20-35	13 ,,
30-40	16 ,,
35-50	18 ,,
45-65	20 ,,
60-80	22 ,,
75-100	25 ,,

Table of Fuse Wires.

APPROXIMATE FUSING CURRENT IN AMPS.	APPROXIMATE STANDARD WIRE GAUGE		
	TIN	LEAD	COPPER
5	25	23	38
10	21	20	33
15	19	18	30
20	17	17	28
25	16	15	26
30	15	14	25
35	14	13	24
40	14	13	23
45	13	12	22
50	13	12	21
60	12		21
70			20
80	Strip fuses above this gauge	Strip fuses above this gauge	19
90			18
100			18
120			17

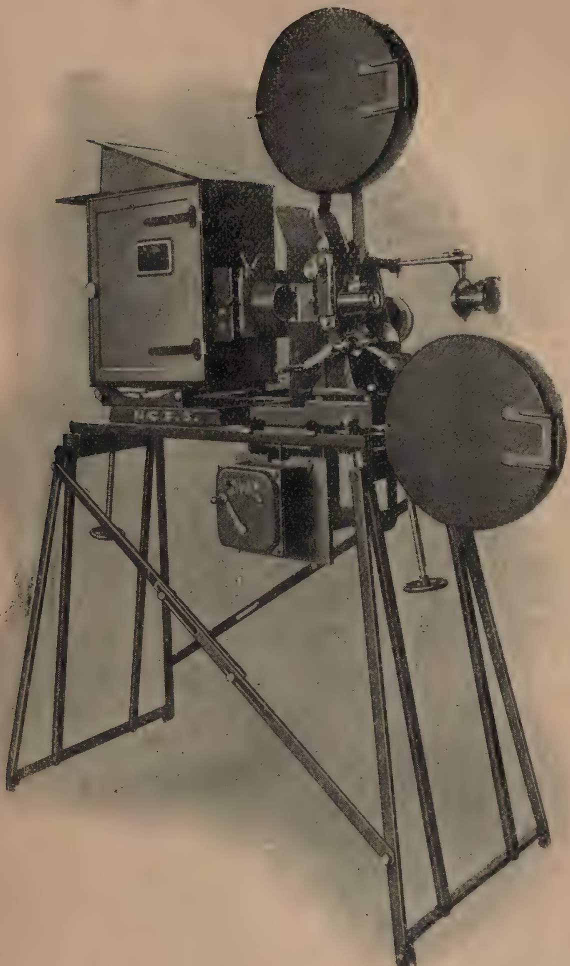
NOTE.—The full normal load on a fuse should be two-thirds of its fusing load. For projector arcs, however, it is wise to allow a margin of 50 per cent., or double the current between full and fusing load. Always use copper wire for arc fuses.

Synopsis of Chapters.

PART 1.

PART 2.

PART 3.



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